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OF
RECENT CASES OF TETANUS IN THE BRITISH EXPEDITIONARY FORCE.
WITH SPECIAL REFERENCE TO THEIR TREATMENT BY ANTITOXIN.

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SOME of the medical problems of the war, though of much scientific interest, are less urgent than others, and may well await the leisured study which will without doubt be given to them after its conclusion, but others which are more urgent appear to call for at least a partial attempt to reach agreement before the campaign grows older. Prominent among these appears to us the subject of the specific treatment of tetanus, upon which there exist wide differences of view, both as to the usefulness of antitoxin at all and, admitting its value, as to the system of its employment which may be expected to yield the best results.

Earlier in the war information with regard to tetanus in the Army in France was collected by one of us (W. B. L.) and summarised in one of the sections of the official "Memorandum on the Treatment of Injuries in War," which was published in July, 1915, and circulated to all medical officers. Further experience of the treatment of the disease has accumulated since then, but much of it relates to comparatively small groups of cases observed in a single hospital, and cases fortunately have on the whole been so few that a number of general hospitals may not have seen one for months. Recently a Tetanus Committee appointed by the War Office, under the chairmanship of Surgeon-General Sir David Bruce, has collected a large amount of most useful information in connexion with the cases which have been treated in home hospitals, and have published their results and recommendations, partly in the form of circular memoranda and partly in an article in THE LANCET of Dec. 2nd, 1916, by Sir David Bruce. We have remodelled some of our tables upon those adopted by Sir David Bruce, so that they may be read as complementary one to the other, and may in this way serve to bring into greater relief the points in which the experiences of home hospitals are in contrast or in accord with those acquired in the Expeditionary Force.

Early last summer it was felt that we had reason to anticipate the occurrence of a certain amount of tetanus among the large number of wounded to be expected during the coming offensive on the Somme. Although since the days of the battle of the Aisne strict orders exist that every wounded man should receive a prophylactic injection of tetanus antitoxin, and it is exceedingly rare that this is for any reason omitted, still it is well recognised that this cannot confer absolute protection. The severe character of many of the wounds is only too familiar to us all, and the heavy coating of foul mud, with which skin and uniform are almost always plastered, renders it certain that very large doses of anaerobic and other bacteria are at times driven deeply into the devitalised tissues.

Arrangements were therefore organised for the collection of detailed information in respect of every case of tetanus occurring in France, a number of questions being asked on a form which had to be completed and sent to headquarters on the termination or final disposal of the case. The information given on the sheets was then transferred to cards, which facilitated the analysis of the various points under inquiry. On the whole, the required details have been very accurately recorded, but it will be realised that at times of heavy pressure in field ambulances and casualty clearing stations it is often difficult or impossible to obtain and record the full details on certain points. These must later be ascertained, if at all, from a man who may be too ill to cross-examine or who may own the notoriously inaccurate memory of at least the old soldier for such points as dates and hours.

We have classed the cases simply into those who died and those who recovered. At first we divided them into three classes: (1) Those whose deaths were attributed solely to tetanus; (2) those whose deaths were in larger part attributable to complications, such as severe sepsis, gas gangrene, secondary hæmorrhage, &c.; and (3) the recoveries. It was found, however, that the difficulties of deciding in which subdivision to place the fatal cases were too great and too uncertain. A simple distribution into the two classes has the disadvantage that the total deaths from tetanus inevitably include a number of cases in which the condition of the wound, the exhaustion of the patient, or some complication were in themselves quite sufficient to account for death. They also comprise cases in which it was definitely stated that all symptoms of tetanus had disappeared before death. Such cases naturally weigh the scales against whatever system of treatment had been employed for the tetanic symptoms. On the other hand, however, the symptoms recorded in some cases have been so slight as to suggest the possibility that they might not have been due to tetanus at all; and, if this were so, such cases would form a counterweight to those whose death was not due to tetanus.

The present analysis is based upon 160 cases which occurred in hospitals in France between July 1st and Oct. 31st, 1916. Of these cases 118 died and 42 recovered, a case-mortality of 73·7 per cent. This mortality may be contrasted with that of the group of cases, already alluded to, examined by one of us in the spring of 1915. In that series, among 179 cases there were 140 deaths, a case-mortality of 78·2 per cent. This, as far as it goes, does not disclose any considerable degree of improvement in the treatment employed. Both series show a heavier death-rate than that which has been recorded for the cases treated in home hospitals where, during the first year, out of 231 cases analysed by Sir David Bruce, there was a case-mortality of 57·7 per cent., and, for the second year, up to July 31st, 1916, out of 195 cases a mortality of 49·2 per cent.

These four series show a slight improvement in case-mortality on each side of the Channel, but also make it clear that cases are more fatal in France by about 25 per cent. The causes for the latter fact are so obvious as to need no labouring. The most desperate wounds, which it would be dangerous to move, and which are therefore detained in clearing stations or base hospitals, are just those which are most likely to develop tetanus, and, further, the complications of severe sepsis, gas gangrene, &c., which must be more in evidence closer to the line than in home hospitals, more frequently play a large part in determining a fatal issue in cases of tetanus.

INCIDENCE.

It is not permissible at the present moment to give any information upon the actual incidence of the disease among the wounded, or to contrast one period of the war with another from that point of view, but there can be no harm in mentioning an impression, which we have gathered from the figures in question, that the highest incidence will eventually be found to be associated with periods during which heavy fighting took place in wet weather. This, after all, might have been anticipated, as it is obvious that, under such conditions, the change from dust to mud will mean a heavier bacterial inoculation of the wound.

An analysis of the influence of the prophylactic dose of antitoxin upon the general incidence of the disease must, for the same reason, be passed over; but this is, fortunately, a procedure which is so fully accepted, not only by ourselves but by our Allies and our enemies, that it stands in little need of further statistical support. Were it not for the universal acceptance of the protective value of this dose we feel sure that any analysis of the subject would have had to deal not with a few hundred cases but with many thousands.

THE INFLUENCE OF THE SEVERITY AND CONDITION OF THE WOUNDED.

In connexion with each case information was asked for on a number of specific points, and among these were queries as to the existence of severe sepsis or gas-infection of the tissues. Details were also asked to the nature and severity of the wound itself and whether it was single or multiple. Table I. shows the frequency with which these factors were

encountered in each group—i.e., among 113 fatal cases and 42 recovered cases. (It will be understood that, where the total number of cases shown in any table does not reach 160, the required information had not been obtained in every case.)

The table shows, as might be expected, a considerably higher percentage occurrence of these conditions among the fatal cases. The most striking contrast is that shown in the

TABLE I.—*Condition of Wounds as Regards Sepsis, Presence of Gas Gangrene, &c.*

—	Severe sepsis.	Gas gangrene.	Extensive or severe wound.	Multiple wounds.
Fatal—113 cases ...	88 (78%)	61 (54%)	98 (87%)	62 (55%)
Recovered—42 cases	24 (57%)	5 (12%)	26 (61%)	18 (43%)

much greater frequency of gas gangrene as a complicating factor in the cases which terminated fatally, no less than 54 per cent. of these cases having been noted as suffering from this grave complication. Its dangerous nature is but too well known, and its frequency among these cases is, to our minds, one of the chief causes of the relatively higher death-rate from tetanus in France as compared with the experience at home.

Another point in connexion with the factors complicating a judgment on the results of treatment appears to be the site of the wound, independently of the influence of sepsis or gangrene. It has been noted by us that a fatal issue is more common when the body, as distinguished from the limbs, has been wounded. Thus, as will be seen in Table II., out of 115 fatal cases, 61, or 53 per cent., were cases in which the

TABLE II.—*The Position of the Wounds in Reference to the Mortality.*

—	Body.	Limbs.
Fatal: 115 cases	61 (53%)	54 (47%)
Recovered: 42 cases	18 (43%)	24 (57%)

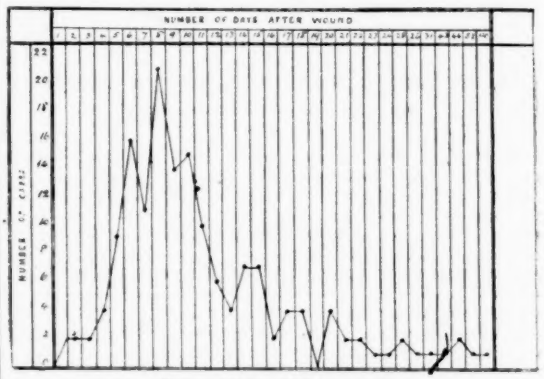
Note.—When wounds occurred both on the body and the limbs the case is counted only under the heading "body."

wound or some of the wounds involved the head or trunk, the balance of 54 cases, or 47 per cent., being wounds of a limb or limbs. On the other hand, of 42 cases which recovered 18, or 43 per cent., were wounds of the body, the remaining 24 recoveries, 57 per cent. of the whole, having received wounds of the legs or arms only. The difference in these figures, though not very marked, appears suggestive, and the heavier mortality of the body cases may not improbably be related to the shorter distance which the toxin has to travel in order to reach the spinal cord and the nervous centres.

THE INCUBATION PERIOD.

The interval which elapsed between the wound and the first evidences of tetanus was recorded in 157 cases and a curve has been constructed, similar to that in Sir David Bruce's papers, that the experience in France may be contrasted with that at home. The average incubation period of all the cases was 12·03 days. Of the fatal cases, 115 in number, the average period was 10·7 days, and of the 42 recoveries it was 14 days. This confirms once again the general experience that the shorter the interval between the wound and the attack the poorer the chance of the patient. At the same time, this difference is less marked than might have been expected, being only a fraction above three days, and it corresponds closely to the figures reported by one of us earlier in the war, where the difference was even smaller, 2·74 days. Comparing our curve of the incubation periods with that of the home cases they appear very similar, except that the peak of the curve in France is reached at an earlier day than in England, the eighth as contrasted with the eleventh. This is only what might have been anticipated as a larger proportion of the early and the acute cases fall to us. The shortest incubation period mentioned—two days—occurred in two instances, but in one of these there was an element of doubt as to the exact day of wounding. The other was a slight case which recovered, the presumed source of infection having been a small cut on the index finger. On the other hand, cases of latent or delayed tetanus are naturally more common in home hospitals, the two in our list with the longest recorded intervals after wounding being, respectively, 52 days and 90 days. Each of these was fatal; the latter was presumed to have originated from an abrasion of the elbow, and in the case of the former an operation had been performed 11 days before the onset of the symptoms of tetanus.

As regards this interesting subject of delayed tetanus, in which it is to be presumed that spores remain undestroyed in the tissues till they are in some way stimulated to germination, we have 13 cases in our series in which the



Curve of the incubation period.

disease did not make its appearance until 21 days or more had elapsed. This may perhaps be assumed to be the limit of the normal incubation period, although the phrase is an awkward one to employ in the case of a bacterial disease in which the germs are introduced as spores which, theoretically, may lie dormant but living in the tissues for an indefinite time. Of these 13 cases, 8 died and 5 recovered. The figures are small, but the recovery rate in this group compares favourably with that of the whole series. The average incubation period of the 8 fatal cases was 36·3 days and that of the 5 recovered cases 29·4 days.

INFLUENCE OF OPERATION BEFORE THE ONSET OF TETANUS.

Table III. shows a list of the 34 cases in which operative interference of a grave nature had been resorted to prior to the development of the first symptoms of tetanus. Of these 34 cases 26, or 76·5 per cent., died, while 8 recovered, a recovery rate of 23·5 per cent. In 4 cases the onset of the tetanus occurred on the day following the operation and in another 4 cases on the second day after operation. In three instances the initial prophylactic subcutaneous dose had been repeated, in two of them 500 units being given a week after the first one. The third case received a second 500 units 4 days after the first and 1500 units 11 days later, on the day of the operation. Of these 3 cases 2 died and 1 recovered, but in the two fatal cases death was not considered as being primarily due to tetanus. The case which had received the three prophylactic doses died, but death was considered to have been due to sepsis and inanition; there had been no convulsions for 6 days before death. Out of 9 cases where death occurred within 3 days of operation 7 were amputation cases; in the 2 remaining ones the wounds and the operations involved the thorax. On the other hand, out of 8 recoveries 3 only were amputations, and only in one case was the thorax involved.

It may be noted that 34 out of our 160 cases fall to be described in this category, as contrasted with the 15 cases out of a total of 195 shown on Sir David Bruce's last communication. This disproportion is readily understandable as these grave operations are naturally demanded more often, and at an earlier moment, in France than in the case of wounded men whose condition was considered such that they could bear the journey to England without undue risk.

INFLUENCE OF OPERATION AFTER THE ONSET OF TETANUS.

The practice of operating after tetanus has declared itself appears to be dying out in France. Table IV. deals with only 9 such cases, and no case of this nature has been reported to us since the end of September. Of the 9 cases 7 died and

2 recovered, a case mortality of 77·7 per cent. Of the 2 cases which were most quickly fatal—viz., 1 day and 1½ days—it may again be remarked that each was a body wound; the operations apparently involved much manipulation and may thus have opened up fresh channels for the absorption of toxin by a short route. Among the 7 deaths there were 3 amputations, but, on the other hand, both of the recoveries were also amputation cases.

The figures dealt with in these two tables III. and IV. are too small to throw fresh light on a side of the problem which has been much discussed, but we have no doubt as to the wisdom of giving a sufficient prophylactic dose a short time before a contemplated operation, and we believe that it is generally agreed to be wise to refrain from any avoidable disturbance of the wound, or anything in the nature of a severe operation, once tetanus has declared itself, at least until there is some sign of abatement of the symptoms and until a sufficient amount of antitoxin has been administered. The latter question will be mentioned again below.

TABLE III.—*Occurrence of Tetanus after Operative Interference with the Wound.*

No. of case.	Onset of tetanus. Days after wound.	Onset of tetanus. Days after operation.	Nature of wound.	Nature of operation.	Recovered or died.	Duration of disease in days.
			Leg.			
J. 13	8	1		Supracondylar amp.	D	1
J. 15	11	7	Back, face, hands, thigh, legs (bomb).	Incisions. Removal of necrotic tissue.	D	19
J. 21	8	5	L. thigh, large flesh wound; frac. femur.	Amp. middle thigh.	D	1
J. 22	18	11	Penetrating chest, L.; empyema.	Resection.	D	7
J. 23	6	3	Shrapnel wd. R. arm and fingers, L. arm, both legs, and buttocks.	Exploration and drainage.	D	4
J. 25	21	9	Scalp, finger, thigh, R. arm and elbow.	Ligature brachial for sec. hæmorrhage.	D	7
J. 26	8	2	L. shoulder, R. thigh.	Amp. at shoulder-joint.	D	2
J. 30	12	10	L. forearm. Severe flesh wounds.	Amp. at shoulder.	R	—
A. 11	14	4	Chest. Back.	Drainage of empyema.	D	5
A. 23	9	3	L. thigh and leg. Fracture. R. leg lacerated.	Amp. L. leg above knee. Free excision of muscle.	D	2
A. 24	10	2	Post. thoracic. Hæmothorax L.	Aspiration.	D	1
A. 26	15	12.1	Dorsum foot, involving bones.	Excision and removal of bone (1); amputation (2).	D	4
A. 27	12	8	G.S.W. chest, penetrating lung.	Extraction of F.B. chest.	D	4
A. 35	35	32	Frac. femur into knee-joint.	Excision and drainage of joint.	R	—
A. 29	26	16	Penetrating chest. Cmpd. fract. of forearm	Resection for empyema. Cleansing of arm wound.	R	—
S. 1	6	2	R. shoulder, upper arm	Excision and drainage.	D	6
S. 7	14	11.5	G.S.W. L. leg. Post. and outer aspect.	1. Removal of F.B.; drainage. 2. Knee-joint re-opened.	D	6
S. 14	8	5	L. leg shot away below knee-joint. R. leg and ankle also wounded.	Amputation.	D	3
S. 18	52	11	Cmpd. fract. L. humerus	Amp. for severe sec. hæmorrhage.	D	4
S. 24	8	1	G.S.W. L. hand.	Amputation.	D	3
S. 44	12	6	Lower part of back, non-penetrating; also wound neck.	F.B. removed neck (2).	D	4
S. 47	21	16	R. leg, L. thigh, R. arm, several back.	Amp. R. thigh.	R	—
O. 3	15	12.6	Shell wd. R. buttock-F.B. lodged in ileum.	1. Excision. 2. Removal of F.B.	D	13
O. 10	26	23	L. leg, thigh, and foot; frac. tibia and metatarsal. F.B. in cornea.	Amp. thigh, upper third.	D	2
O. 11	17	16.8	G.S.W. both legs.	1. Amp. upper 3rd L. thigh. 2. Opening up of stump.	D	13
O. 19	11	6	G.S.W. head, L. temporo-maxillv. joint.	Trephined. F.B. removed.	R	—
O. 20	3	0	G.S.W. R. thigh.	Opened up.	R	—
O. 22	7	4.2.1	G.S.W. L. chest.	1. Aspiration. 2. Ditto. 3. Rib resection.	D	2
O. 24	25	10	Both legs, R knee and abdominal wall.	Drainage.	D	9
O. 29	18	14.10	Cmpd. fract. L. upper arm.	1. Cleansing, drainage. 2. R. arm incisions. L. arm disarticulation at shoulder.	D	11
O. 31	6	4.2	Cmpd. fract. L. ulna, two large dirty wds. Two large dirty wds. L. calf.	1. F. B. removed. 2. Cleansing. Removal F.B.	D	4
O. 35	43	36	Penetrating R thigh. Commin. frac. femur.	Post. wound enlarged for drainage.	D	11
O. 41	44	9	Cmpd. fract. leg.	Amp. below knee.	R	—
O. 43	9	4	Large, over R. scalp. Small, over R. lat. dorsi.	Incision. Drainage.	R	—

TABLE IV.—*Operative Interference after Appearance of Tetanus.*

No. of case.	Onset of tetanus. Days before operation.	Nature of wound.	Nature of operation.	Recovered or died.	Duration of disease in days.
J. 4	0	G.S.W. R. shoulder, frac. scap.	Incision, cleansing.	D	1½
J. 7	0	Shell wound R. thigh, frac. femur.	Amp. on appearance of symptoms.	D	(?)*
J. 10	1	Perf. L. leg above ankle.	Amputation.	R	—
J. 11	1	L. knee-joint.	Amputation.	D	(?)*
J. 16	0	G.S.W. R. upper arm.	Incision, drainage.	D	3
J. 29	2	G.S.W. L. foot.	Amputation through calf.	R	—
A. 31	3	Thigh.	Removal F B. and drainage.	D	8
S. 3	0	Near R. ant. sup. spine, frac. of ilium.	Free opening up of wound.	D	1
S. 5	3	R. tibia cmpd. frac., wounds R. leg and perineum.	Femoral artery tied.	D	5

* Not stated.

THE PROPHYLACTIC USE OF TETANUS ANTITOXIN.

Although, as has been said, the influence of this upon the general incidence of tetanus in the wounded must be left on one side, there remain some points in connexion with it which are of interest and may be discussed without indiscretion.

It is, of course, well known that the earlier the preventive dose is given after the receipt of the wound the more likely is it to be of use. At the same time there is little positive information as to the effects of delay. An effort was therefore made to obtain precise details as to the number of hours which had elapsed between wound and injection. This was obtained in a considerable proportion of the 160 cases—viz., 66. It would have been easy to group for analysis a still larger number than this if one had been content to include cases in which the replies gave one a reasonable certainty that the dose had been given within 24 hours, but only those have been accepted in which a definite statement was forthcoming as to the fact of inoculation, the dosage, and the number of hours after the wound at which the dose was given.

Of the 43 cases which received within 24 hours a preventive dose of 500 or more units—less is never given—62·7 per cent. were fatal and 37·2 recovered. On the other hand, of 23 cases in which the giving of the antitoxin was, for one reason or another, delayed beyond 24 hours, 86·9 per cent. died and only 13 per cent. recovered. These figures are given for what they are worth, and it should be borne in mind that delay in giving the preventive inoculation is almost always caused by the impossibility of removing the wounded man from the place where he was hit till military conditions permitted. Such cases are therefore specially liable to gangrene and to the more severe forms of septic trouble.

These 66 cases are further analysed in Table V. to see whether there was any noticeable correlation between the time of administration of the preventive dose, the average size of this dose and the length of the incubation period. The chief points which emerged from this were that the average incubation period of the recovery cases who got their preventive dose within 24 hours is longer than that of the other classes, and that of those whose dose was delayed, and who yet recovered, the average size of the dose given was large—viz., 915 units.

No prophylactic dose was given in 15 of the cases, and 9 of these died—i.e., 60 per cent. It is to be noted, however, that of the 6 who recovered 5 were instances of men whose injuries, being of the nature of scratches or abrasions, were so slight that they did not report sick, and hence received no dose of serum. Others of those who received

no serum were of that unlucky class who have only been picked up some days after their injury, having lain untound in some shell-hole or perhaps in such a portion of "No man's land" as made it impossible to reach them. Their condition on rescue has sometimes been so critical that the medical officer did not consider it wise to give an inoculation.

TABLE V.—*Correlation between the Amount of Prophylactic Dose given, the Time of Administration, and the Incubation Period.**

—	Interval between wound and prophylactic dose	Number of cases.	Percentage.	Average prophylactic dose	Average incubation period.
Fatal cases, 47	Under 24 hours	27	57·4	655 units.	10·6 days.
	Over 24 ,,	20	42·6	585 ,,	10·5 ,,
Recovered cases, 19	Under 24 hours	16	84·3	830 ,,	14·7 ,,
	Over 24 ,,	3	15·7	915 ,,	11·0 ,,

* Incubation period in all cases is reckoned as the interval between the wound and the onset of tetanus, whether there was an intermediate complicating factor, such as an operation, or not.

THE THERAPEUTIC USE OF TETANUS ANTITOXIN.

The "questionnaire" completed in all cases of tetanus was principally designed to obtain accurate information upon the details of antitoxin administration, the number, size, and route of introduction, and the dates of each dose being asked. This information has been given in every case and has formed the subject of close study from as many different points of view as possible. Our thanks are due to the officers who furnished us with these details, collected often under conditions of great stress. Our object, it need hardly be said, was to search the collected results for any indications for or against a particular system of dosage or a particular channel, or combination of channels, of administration of the antitoxin.

Of the 160 cases, all but three, each of them fatal, were treated with antitoxin, so the tables now to be discussed deal with 157 cases.

The number of possible variations in the treatment adopted, as well as the various complications already alluded to, make it a very difficult matter to arrive at clear-cut answers to any given question, and had there been more general agreement on the usefulness of antitoxin in the treatment of declared tetanus and on the best methods of employing it, we should have preferred to wait till more material had become available for analysis. Still, certain points have rather forced themselves upon our notice in our inquiry into the returns, and we believe them to be of sufficient importance to put on record forthwith.

The paper of Sir David Bruce, dealing as it does with a further 175 cases treated with antitoxin in home hospitals, forms a ready means of multiplying experience on certain points, and we shall frequently avail ourselves of the opportunity thus given of comparing our respective experiences and conclusions.

In examining the results of a certain line of treatment we have, as already said, been content to accept as the criterion of success or failure the survival or death of the patient, leaving out of consideration any statement that death was due in the main to some other cause than tetanus.

Table VI. shows the cases distributed in accordance with the total amount of antitoxin which they had received, being arbitrarily divided for this purpose into eight classes. In each group is shown the number of deaths, the case mortality, and the channels of administration by which the serum had been given. As will be seen, there are no fewer than 15 possible combinations of the four routes which we have had under consideration, and there are instances of each of these combinations having been employed. We have taken no account of a few cases in which antitoxin was said to have been given by the mouth or by the rectum, and there has been no report of its local application to the wound. For the sake of brevity we shall in our tables employ an initial letter to signify the particular route, thus "T" = the intrathecal method, "V" = the intravenous, "S" = the subcutaneous, and "M" = the intramuscular. We shall leave the tables largely to speak for themselves, when they have anything to say, confining our comments to such points as appear to us of significance or as needing further explanation or emphasis.

As regards Table VI., the chief point sought was any broad indication of the effects of the total dosage of antitoxin. In studying this point we at one time divided our cases accordingly as they had received a total dosage of less or more than 20,000 units. Although we decided later to abandon this method for the succeeding tables as too complicating, we may return to it here as bringing out the desired point somewhat more clearly. As will be seen, the first five classes, those in which the total dosage had been below 20,000 units, comprise 116 cases, of whom 91 died, a case mortality of 78·4 per cent. The remaining 41 cases received more than 20,000 units, and of them 24 died, a case mortality of 58·5 per cent. There is therefore a balance of 20 per cent. in the favour of the larger dosage. Turning to a somewhat similar table in connexion with the cases treated in home hospitals, and dividing the 175 cases therein analysed into similar groups, below and above a total dosage of 20,000 units, we find that of 108 cases in the small-dose category, 61 died, a case mortality of 56·4 per cent., while of the 67 cases in the large-dose class only 21 died, a case mortality of 31·3 per cent. The balance here in favour of the larger total dosage is 25 per cent., a difference even more pronounced than in our own series.

Taken together, we think there can be little doubt that they demonstrate the better results obtainable from the higher dosage. We have very closely scrutinised our cases to see what influence certain obviously possible fallacies might have had upon this conclusion. For instance, it is possible that relatively small dosage may have been adopted of necessity because the case was rapidly fatal, either from tetanus or a complication; or, on the other hand, the case may have been so slight that the dosage was originally small and was rapidly abandoned. Such cases undoubtedly occur, but against them may be set, unfortunately, the equally certain fallacy that even in severe and prolonged cases the dosage recorded has, in our view at least, been altogether inadequate, owing to an obvious unbelief in the value of specific treatment. These, and some other disturbing factors, we think tend to cancel one another and we do not consider that they lessen materially the significance of the figures just quoted.

TABLE VI.—*Showing the Total Number of Cases Treated by Serum.*

Dose (in units).	No. of cases.	Died.	Case mortality.	Methods of administration *														
				T.	V.	S.	M.	T.V.	T.S.	T.M.	V.S.	V.M.	S.M.	T.V.S.	T.S.M.	V.S.M.	T.V.M.	T.V.S.M.
Below 500	5	4	80%	3	—	2	—	—	—	—	—	—	—	—	—	—	—	—
501- 1,000	3	3	100%	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—
1,001- 5,000	49	42	85%	12	5	16	2	2	8	2	—	—	—	1	—	1	—	—
5,001- 10,000	25	16	64%	6	—	4	1	3	6	2	—	—	—	1	1	—	1	—
10,001- 20,000	34	26	76%	2	1	2	1	5	9	5	1	—	—	6	1	—	1	—
20,001- 50,000	25	16	64%	—	—	1	—	1	4	3	2	—	—	10	2	—	2	—
50,001-100,000	14	6	43%	—	1	1	—	3	1	1	1	2	—	2	—	—	1	1
Above 100,000	2	2	100%	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Totals... ...	157	115	73·7	25	7	7	4	14	28	13	4	2	1	20	4	1	5	2

* T. = Intrathecal. V. = Intravenous. S. = Subcutaneous. M. = Intramuscular.

The cases are grouped according to the total dosage given, together with the case mortality. The groups are subdivided to show how many cases fall into each one of the 15 possible combinations.

TABLE VII.—*Showing the Total Number of Cases Treated by Serum (with or without Non-specific Treatment), together with the Number of Deaths and the Case Mortality. The Table also shows the Number of Cases treated by any one of the Four Available Routes alone or in Combination with One or More of the other Three Routes.*

Methods of administration.	No. of cases	No. of deaths.	Case mortality	Methods of administration.	No. of cases.	No. of deaths.	Case mortality
			Per cent.				Per cent.
T.	25	21	84	S.M.	1	1	100
V.	7	7	100	T.V.S. ...	20	17	85
S.	27	15	55	T.S.M. ...	4	1	25
M.	4	3	75	T.V.M. ...	5	3	60
T.V.	14	11	78	V.S.M. ...	1	1	100
T.S.	28	21	75	T.V.S.M. ...	2	1	50
T.M.	13	9	69				
V.S.	4	4	100				
V.M.	2	0	0	Totals ...	157	115	73

The next table, VII., sets out the cases treated by antitoxin and it shows for each route or combination of routes by which the serum was given, the number of cases, the deaths,

and the case mortality. The uneven size of the groups, and their very number, make evident the futility of any attempt to form conclusions from a consideration of the degree to which the case-mortalities are above or below the mean rate of the whole 157 cases. A better opportunity is afforded by a consideration of the series of Tables VIII., IX., X., and XI., in which the cases are grouped on a different system. Here we have placed together all cases in which one particular route, whether alone or in combination with others, formed part of the system of treatment, a separate table being devoted to each of the four—"T.," "V.," "S.," and "M." Each of these will now be briefly considered.

Table VIII. deals with the intrathecal route, employed either alone or combined with others. It was used alone in 25 cases, with a mortality of 84 per cent., and this, with the single exception of the combination "T.V.S.," is, it will be noted, the highest rate shown in the table. Looking to Sir David Bruce's figures we see that "T." was used alone in 7 cases, of which 5 died, a mortality of 71·4 per cent., the highest mortality of any group analysed in his paper. So far this does not impress one favourably. Turning to the use of "T." in combination with others, the only other point we shall call attention to is that in each of the four groups

TABLE VIII. *shows all Cases Treated by the Intrathecal Route, and* TABLE IX. *shows all Cases Treated by the Intravenous Route, either Alone or in Combination with One or More of the other Routes, together with the Number of Deaths and the Case Mortality.*

Table VIII.—Intrathecal Route. Table IX.—Intravenous Route.

Methods of administration.	No. of Cases.	No. of deaths.	Case mortality	Methods of administration.	No. of Cases.	No. of deaths.	Case mortality
			Per cent.				Per cent.
T....	25	21	84	V.	7	7	100
T.V.	14	11	79	V.T.	14	11	79
T.S.	28	21	75	V.S.	4	4	100
T.M.	13	9	69	V.M.	2	0	0
T.V.S. ...	20	17	85	V.T.S. ...	20	17	85
T.S.M. ...	4	1	25	V.T.M. ...	5	3	60
T.V.M. ...	5	3	60	V.S.M. ...	1	1	100
T.V.S.M. ...	2	1	50	V.T.S.M. ...	2	1	50
Totals... ...	111	84	75	Totals... ...	56	44	80

TABLE X. *shows all Cases Treated by the Subcutaneous Route and* TABLE XI. *shows all Cases Treated by the Intramuscular Route, either Alone or in Combination with One or More of the other Routes, together with the Number of Deaths and Case Mortality.*

Table X.—Subcutaneous Route. *Table XI.—Intramuscular Route.*

Methods of administration.	No. of cases.	No. of deaths.	Case mortality	Methods of administration.	No. of cases.	No. of deaths.	Case mortality
			Per cent.				Per cent.
S....	27	15	55	M.	4	3	75
S.T.	28	21	75	M.T.	13	9	69
S.V.	4	4	100	M.V.	2	0	0
S.M.	1	1	100	M.S.	1	1	100
S.T.V.... ...	20	17	85	M.T.S. ...	4	1	25
S.T.M. ...	4	1	25	M.T.V. ...	5	3	60
S.V.M. ...	1	1	100	M.V.S. ...	1	1	100
S.T.V.M. ...	2	1	50	M.T.V.S. ...	2	1	50
Totals ...	87	61	70	Totals ...	32	19	59

showing the lowest mortality the intramuscular route has formed a part of the combination. The moral would appear to be that if one employs the thecal route at all it is better to use it in combination than alone. This is even more strikingly illustrated in the home figures, where the relative death-rates are 71·4 per cent. and 46·7 per cent.

Table IX. deals in a similar way with the intravenous route alone or combined. Of 55 cases in the group 44 died, a mortality of 80 per cent., and we have the striking fact brought out that no case treated by this channel alone recovered. In the home figures the mortality in 7 cases treated by "V." alone was 57 per cent., the second highest in the list. Looking again at the results of the various combinations of "V." with other channels, one again notes that the three lowest mortalities are in groups in which "M." appears.

Table X. shows the subcutaneous route alone and in combination with others. Of 87 cases in which this route was employed the general case mortality was 70 per cent. When used alone, in 27 cases the mortality was considerably lower, 55 per cent., and here the apparent effect of combining this route with others is bad, except in two particular combinations, into each of which "M." again enters. In the home figures the mortality from cases treated by "S." alone was 50 per cent., but there is no information as to the frequency with which it was employed in combination.

Table XI., the last of this group of four, deals in similar fashion with the intramuscular route. Of 32 cases in which it played a part 19 died, a case mortality of 59 per cent., the lowest figure by 11 per cent. of the four tables. The groups are too small here to afford much information, and, so far as the figures go the mortality resulting from its use alone, 75 per cent., contrasts unfavourably with the mean rate of 59 per cent. This group, however, deals with but 4 cases and may be usefully supplemented by the home figures, which show that of 8 cases treated by this method alone only 1 died, a mortality of 12·5 per cent. Combining these 8 cases with our own 4 we have 4 deaths out of 12 cases, a mortality of 33·3 per cent., which is by far the lowest recorded in either series for the results of a single channel antitoxin treatment.

We fully appreciate the many pitfalls into which one may stumble in searching for truth among small figures dealing with cases presenting so many complicating factors; but, so far, our examination of them has given us some strong impressions, all the stronger in that they were by no means anticipated. They appear to us to throw very considerable doubt upon the advisability of employing the intrathecal route, either alone or in combination, and, further, they seem to indicate considerable virtues in connexion with the employment of the subcutaneous and intramuscular channels, particularly the latter. The evidence for and against the intravenous method also leaves one with a feeling of suspicion, particularly in view of the fact that all of the cases treated by this channel alone died.

EFFECTS OF THE DOSAGE OF ANTITOXIN EMPLOYED BY THE SEVERAL ROUTES.

It is obvious, however, that, in considering the results of the various combinations of specific treatment dealt with in the last four Tables VIII., IX., X., and XI. there is a factor of importance which is not disclosed by them, but which it is essential to consider. It is not enough to treat all cases as alike that have received serum treatment by the same combination of routes, we must study the amount and frequency of the dosage by each route if we are to reach a fairer judgment of results. This has accordingly been done, and every individual case has been closely studied from this point of view. A table showing the full details of every dose given in the 157 cases was constructed, but as this would be too elaborate to reproduce we have constructed Tables XII., XIII., XIV., and XV., which, while repeating the classification of cases adopted in Tables VIII., IX., X., and XI., show, in addition, the average amount of antitoxin given by each route in each group of cases. This table enables one to grasp more readily the relative importance to attach to each route in any given combination of routes, and to see how this factor of dosage compares in the cases which recovered and those which died.

Table XII. displays all cases in which the intrathecal route played a part. Contrasting the average dose given by the thecal route in the fatal and recovered cases respectively and in each combination, it will be seen that there is no regularity; in some instances more had been given in the recovered cases, in others less. Looking, then, at the venous fraction, here, too, we see no regularity; a larger dosage by the veins seems in some cases to have been beneficial, in others the reverse. But when we consider the remaining fractions, subcutaneous and intramuscular, in each group into which they enter we notice in all cases that the dosage has been higher, usually much higher, in the recovery cases than in the fatal ones. It should be noted, however, that neither in this nor the succeeding three tables of the series do we attempt to draw any inferences from the two cases in class "T.V.S.M.," the employment of all four routes appearing to us to render any attempt of this sort futile.

Table XIII. deals in similar fashion with the intravenous route in all combinations. Analysis in this group is difficult, as in no less than four of the combinations we have

either no deaths or no recoveries, as well as the group "V.T.S.M.," of which we take no notice. The two groups most suitable for contrast, on account of the number of cases, are "V.T.," where the recovered cases show a larger

TABLE XII. *shows Cases Treated by the Intrathecal Method and* TABLE XIII. *shows Cases Treated by the Intravenous Method, either Alone or in Combination with One, Two, or Three other Methods. Contrast of the Average Amounts of Antitoxin used in the Fatal and Recovery Cases.*

Table XII.—Intrathecal Method.

Method of administration.	Number of fatal cases.	Average amount used by each route.	Number of recoveries.	Average amount used by each route.	Case mortality.
					Per cent
T.	21	3,810	4	7,250	84
T.		4,470		3,000	
V.	11	14,345	3	24,000	79
T.		4,050		8,000	
S.	21	6,950	7	18,000	75
T.		4,970		12,560	
M.	9	6,500	4	27,560	69
T.		6,430		3,750	
V.	17	12,535	3	13,500	85
S.		7,985		25,500	
T.		7,500		4,300	
S.	1	3,000	3	6,170	25
M.		6,000		11,800	
T.		4,170		7,500	
V.	3	15,500	2	5,250	60
M.		8,330		12,750	
T.		18,000		8,000	
V.		100 0 00		14,000	
S.	1	50,500	1	17,500	50
M		34,000		4,500	
Totals	84		27		75

Table XIII.—Intravenous Method.

Method of administration.	Number of fatal cases.	Average amount used by each route.	Number of recoveries.	Average amount used by each route.	Case mortality.
					Per cent
V.	7	13,890	0	—	100
V		14,345		24,000	
T.	11	4,470	3	3,000	78
V.		9,875			
S.	4	18,000	0	—	100
V.				60,000	
M.	0	—	2	24,000	0
V.		12,535		13,500	
T.	17	6,430	3	3,750	85
S.		7,985		25,500	
V.		15,500		5,250	
T.	3	4,170	2	7,500	60
M.		8,330		12,750	
V.		500			
S.	1	1,000	0	—	100
M.		3.000			
V.		100,000		14,000	
T.		18,000		8,000	
S.	1	50,500	1	17,500	50
M.		34,000		4,500	
Totals	44		11		80

TABLE XIV. *shows Cases Treated by the Subcutaneous Method and* TABLE XV. *shows Cases Treated by the Intramuscular Method, either Alone or in Combination with One, Two, or Three other Methods. Contrast of the Average Amounts of Antitoxin Used in the Fatal and Recovery Cases.*

Table XIV.—Subcutaneous Method.

Method of administration.	Number of fatal cases.	Average amount used by each route.	Number of recoveries.	Average amount used by each route.	Case mortality.
					Per cent
S.	15	2,450	12	11,500	55
S.		6,950		18,000	
T.	21	4,050	7	8,000	75
S.		18,000			
V.	4	9,875	0	—	100
S.		60,000			
M.	1	60,000	0	—	100
S.		7,895		25,500	
T.	17	6,430	3	3,750	85
V.		12,535		13,500	
S.		3,000		6,170	
T.	1	7,500	3	4,300	25
M.		6,000		11,800	
S.		1,000			
V.	1	500	0	—	100
M.		3,000			
S.		50,500		17,500	
T.		18,000		8,000	
V.	1	100,000	1	14,000	50
M.		34,000		4,500	
Totals	61		26		70

Table XV.—Intramuscular Method.

Method of administration.	Number of fatal cases.	Average amount used by each route.	Number of recoveries.	Average amount used by each route.	Case mortality.
					Per cent
M	3	7,500	1	3,000	75
M.		6,500		27,560	
T	9	4,970	4	12,560	69
M.				24,000	
V	0	—	2	60,000	0
M.		60,000			
S.	1	60,000	0	—	100
M.		8,330		12,75	
T.	3	4,170	2	7,500	60
V.		15,500		5,250	
M.		6,000		11,800	
T	1	7,500	3	4,300	25
S.		3,000		6,170	
M.		3,000			
V.	1	500	0	—	100
S.		1,000			
M.		34,000		4,500	
T.		18,000		8,000	
V.	1	100,000	1	14,000	50
S		50,500		17,500	
Totals	19		13		59

venous dose and a smaller thecal one than the fatal cases, and Group "V T S.," in which, while the venous average dose is approximately equal in fatal and recovered cases, we are struck by the fact that in three recoveries only half the thecal dose was given, but three times the subcutaneous dose, as contrasted with the dosage given in the 17 fatal cases.

Table XIV., dealing with the dosage of the subcutaneous route, alone or combined, brings out more clearly than the others the observation that, in all groups in which we are able to make a comparison between the dosage in the recovered and in the fatal cases, a much higher average dose has been given to the cases which lived. This is particularly noticeable in the group treated by the subcutaneous method alone, where the average dose has been 4½ times higher in the cases which recovered, and in the two other fair-sized groups, "S.T." and "S.T.V.," in which the subcutaneous dose was respectively 2⅓ and 3½ times greater in the recovery cases. In all, this table impresses us with the value of high dosage when the subcutaneous route is employed.

Table XV., the last of this series, shows the average dose of antitoxin employed in all combinations in which the intramuscular route was used. The various groups in this category are, on the whole, too small to extract from them much guidance in this matter of dosage, but it will be seen that in the largest group, "M.T.," dealing with 13 cases, about four times as much antitoxin was given intramuscularly in the recovered cases as in those which died. In the "M.T.S." cases, in which 3 recovered and 1 died, the intramuscular dose was twice as great in those who lived. On the other hand, in the cases treated by intramuscular injections alone, of which 3 out of 4 were fatal, the only case which recovered received less than half of the average dose given to the fatal cases. On the whole, although the figures are small, we get the same impression here as in the instance of the subcutaneous route—that the apparently favourable effect of employing this channel is associated with a proportionally high dosage.

On regarding these four tables from a general point of view, and without attempting to draw from them more than may reasonably be inferred, we find our suspicions of the thecal and venous routes strengthened, and also some further support for the good impression which has been made on us by a consideration of the results of the subcutaneous and intramuscular routes.

The last table which we shall give, Table XVI., was designed in an attempt to visualise and contrast the results obtained by single-route administration of antitoxin with the results of using that particular route in combination with others.

Looking at the intrathecal results, we see that the case mortality is 10 per cent. higher when this route is used

TABLE XVI.—*Comparing and Contrasting the Results Obtained by Each Individually, with those Obtained by that Route in Combination with One or More Others.*

—	Total cases treated.	Average dosage employed.	Died.			Recovered.		
			Number of cases.	Case mortality	Average dosage.	Number of cases.	Recovery rate.	Average dosage.
Intrathecal route only	25	4,360	21	84%	3,810	4	16%	7,250
Intrathecal cmbd with other routes.	86	5,680 T.	63	73·2%	5,180 T.	23	26·7%	7,060 T.
Intravenous route only	7	13,890	7	100%	13,890	0	0	—
Intravenous cmbd. with other routes.	48	16,966 V.	37	77%	15,062 V.	11	23%	23,360 V.
Subcutaneous route only	27	6,470	15	56%	2,450	12	44%	4,500
Subcutaneous cmbd. with other routes	60	11,780 S.	46	77%	10,178 S.	14	23%	17,036 S.
Intramuscular route only ...	4	6,375	3	75%	7,500	1	25%	3,000
Intramuscular cmbd. with other routes ...	28	14,650 M.	16	57%	11,655 M.	12	43%	18,640 M.

alone, and also that the total dosage given by the thecal route in the fatal cases was considerably higher in the group in which this channel was employed along with others than when it was employed alone. It was remarked, however, that a considerable proportion of the 21 fatal cases treated by the single-route method were exceptionally severe cases of gunshot injuries. In 9 of them death was

attributed by the reporting officer to causes other than tetanus. Thirteen of them died within 24 hours of the first appearance of tetanic symptoms. Of the recovery cases all were noted as being either slight or localised and none of them reached the stage of trismus.

As regards the intravenous channel, attention has already been directed to the fatal issue in all cases treated by this method alone. The high dosage employed will be remarked, as well as the fact that the average dose given to the recovered cases in whom this channel had been used in combination with others was highest of all. In examining the individual records of the 7 fatal cases treated by the venous route only it was remarked that, although they were all severe wounds, the antitoxin was not persisted in in several, though time allowed for its repetition. In only 2 out of the 7 was the dose above 5000 units.

The subcutaneous route employed alone shows the lowest mortality—viz., 56 per cent. Of the 15 fatal cases 7 were severe wounds, in which death was not attributed directly to the tetanus. The dosage employed in these fatal cases was also remarked upon as being very small, in only one of them was it over 3000 units and most received 1500 units or less. Of the 12 recoveries in the single-route group 6 were either localised or slight, but the dosage only fell below 3000 units in one case, which received 500. The wounds in this group were, on the whole, slight.

Too few cases were treated by the intramuscular route alone to allow of effective contrast with those in which this method was associated with others. Of the 3 fatal cases, 2 were specially severe wounds and the intramuscular dosage was moderate. The recovery case, although severe, was, on the other hand, given 3000 units only. The high average dosage given into the muscles in the 12 recovery cases in the combined group, 18,640 units, is also noteworthy.

SUMMARY.

The above analysis of these tables dealing with the therapeutic employment of tetanus antitoxin leaves, we are fully aware, much to be desired, and, at any other time than this, we should have greatly preferred to postpone this article until our material was larger. The importance and urgency of the subject, however, form our justification, and we shall now proceed to summarise the impressions we ourselves have gathered, trusting that we have presented the available facts in such a way that any who wish may do the same.

Our general conclusions would place the alternative channels of administration of the antitoxin in the following order of merit—intramuscular, subcutaneous, intrathecal, and intravenous. Let us consider each separately, emphasising the points of experience or theory which have influenced our judgment. Taking the intravenous route first, as we have placed it last, we are in full agreement with the recommendation of the Tetanus Committee in their revised Memorandum, that this route should not be used; not only does it introduce a risk of anaphylactic shock, from which other methods are practically free, but it appears to us from our records that it has done little, if any, good in treatment. It seems improbable that, even when very large doses are injected into the veins, the antitoxin is likely to be brought to a point at which it is most wanted in a sufficiently concentrated form. Of what is injected only a small fraction can possibly be utilised, and, further, we do not think that the effects of the antiseptic which is mixed with most brands of antitoxin can altogether be neglected when large and repeated doses are injected by this channel.

As to the intrathecal route, we are less inclined to support the recommendation contained in the Memorandum just mentioned when it says: "In a case of tetanus the first thing to do is to give an intrathecal injection of antitoxin." The study of our own cases has not impressed us at all favourably. Sir David Bruce, in his article of Dec. 2nd, considers that the evidence for and against it from his series of cases at home hospitals is not conclusive. We are inclined to go further and consider, from our own tables, and also to some extent from his, that the evidence is pretty strongly against its employment. The theoretical grounds for the adoption of the thecal route are, of course, well known, and depend chiefly on the hope that by bringing antitoxin into more or less close contact with the poisoned nerve cells of the cord we may effect a dissociation between the cell and the molecules of toxin which it has bound to itself. It is known to be very difficult to introduce antitoxin into the cerebro-spinal fluid by means of the blood-stream; hence the direct path chosen in lumbar puncture. We shall not attempt to analyse the experimental evidence bearing upon this subject, but think it will be agreed that a considerable divergence of opinion still exists as to whether what we aim at, a dissociation of toxin from the poisoned nerve cell, is realisable in practice. The good effect of intrathecal injections of serum in some cases of cerebro-spinal meningitis has really no bearing upon this problem, because, in that instance, we are directly attacking a bacillus which we know to be present in the fluid into which we introduce our antiserum. Again, in that disease marked benefit often results from the mere evacuation of the turbid fluid which has accumulated under pressure, without even replacing it by an injection of serum.

Apart, however, from doubts as to the soundness of its theoretical basis, the method appears to us to possess some very definite disadvantages and dangers. For example, the dangers of contamination of the needle track, in spite of scrupulous precautions at the time of operation, must be very considerable in certain cases. At all events, definite comments have been made in connexion with some of our cases that thecal injections have been followed by signs of meningeal irritation, and one of us has seen specimens of cords, removed after death from tetanus, in which there was definite evidence of meningitis having followed the lumbar punctures. Again, although Flexner and others have stated that the amount of antiseptic usually added to antitoxin as a preservative is no impediment to its employment by the thecal route, we do not think that repeated injections of carbolic acid, trikresol, &c., can be altogether a negligible consideration in the case of a canal whose limiting membranes are so delicately constituted and their functions so imperfectly understood, to say nothing of possibly adding to the grave irritation already present in the adjoining nerve cells of the motor tracts owing to the action of tetanus toxin. In at least one case death followed rapidly upon a thecal dose when the patient was said to have been progressing favourably. It was attributed to anaphylactic shock.

Although we have this decided impression that the intrathecal route may be a dangerous one and do not feel its theoretical foundations to be as secure as one would like, still we have a fair number of instances in which the reporting medical officer was struck with the apparent benefit following a thecal dose, and, of course, as our tables show, it has formed a part of the treatment in 27 cases which recovered.

If it is desired to employ this method we think that its use should be very carefully watched, that exceptional care should be taken to guard against possible contamination of the canal through the needle puncture, that the serum should contain no preservative, and that it is undesirable to withdraw more than 10–15 c.c. of cerebro-spinal fluid or to replace this by a greater volume of antitoxin. It might be advisable to employ for this purpose a solution of desiccated antitoxin, which would be free from preservatives, and could be rapidly prepared under sterile conditions in the desired concentration.

The subcutaneous and intramuscular routes may appropriately be considered together, as they are essentially similar in action, each being a comparatively slow and continuous method of dosage as distinguished from the rapid introduction involved in the venous and thecal methods. While we have expressed our unfavourable impressions in respect of these rapid methods, we have in the present case received a strongly favourable impression, which is confirmed to some extent by the results obtained in the home hospitals. Hitherto these two routes have been looked on as merely supplementary to the others and as being of chief value when it was desired to maintain a moderate concentration of antitoxin in the system after the critical period was past, and with a view to warding off a possible relapse. We think, on grounds both of theory and observation, that they might be promoted to a more dignified position. We believe our records show that when these two paths of introduction have been utilised freely, and where the dosage has been sufficient, the results as regards saving of life have been more satisfactory than when they were not utilised or were used in altogether too restricted a fashion.

Turning to the theoretical aspect, we may follow for a moment the path which the toxin is believed to travel on its way to the central nervous system. It is generally accepted that it travels by way of the motor nerves, though it is still a matter of debate whether it progresses through the axis

cylinders or through the lymphatics which accompany these nerves. At all events, the general blood stream and lymph stream are considered to play but a small part. Once the tetanus spores have found conditions suitable for their germination, and the bacteria themselves are multiplying without interference in some nook or cranny of the wound, the formation of the toxin goes on continuously. It is possible that this toxin at times may accumulate locally and only upon some local disturbance of the wound does it become absorbed in quantity, producing probably a rapid and fulminating attack. At other times the toxin may be slowly but continuously taken up by the nerves, as it is formed, and this may lead to a comparatively slow onset of the disease. In either case we have then to deal with a localised factory of the toxin, which is either continuously or discontinuously absorbed along the nerves. Looking now at the possibilities of neutralising this toxin, we have in our hands a perfect antidote, of that there can be no question, and the problem becomes clear that it is an affair of trying to bring antidote and poison in contact with one another within the shortest time and under the most favourable conditions for neutralisation to take place. The alternative lines of attack are three and no more—the local factory of toxin, the line of transit of the toxin to the central nervous system, and the central nervous system itself. The first would, of course, be the ideal one to select, but, unfortunately, we cannot locate it with precision, and attempts to reach it and to deal with it by surgical measures, or by the local application of various antiseptics or oxidising agents, more often than not end in failure or in a sudden outpouring and absorption of toxin. The last, the central nervous system, is difficult to reach and, at the best, this is an attempt to recapture from the enemy a position which they have already taken and hold in great strength. The method of intrathecal injection aims at such a local assault but depends for its possible success on two assumptions—namely, that the antitoxin shall actually come into contact with the nerve cells which are poisoned and, having come into contact with them, shall be able to neutralise or withdraw from these cells the tetanus toxin which had reached them. In practice the results of this line of attack appear to us, from our own and the home cases, to be most disappointing.

The chances of success by employing the third alternative, an attack on the lines of communication, would appear more hopeful, especially if this could be done by some method which would keep up the antitoxin attack steadily and continuously on the path over which it is probable the toxin must travel. To effect this there appear to be grounds for considering that the subcutaneous and the intramuscular channels offer greater prospects of success than the intravenous method, for the reason that the dose of antitoxin thrown into the veins is immediately diluted by the whole volume of the blood and, subsequently, of the lymph, and by the time any portion of it comes round to the site where it is required it must be very dilute indeed. On the other hand, antitoxin injected beneath the skin or into the muscles is said to be absorbed but slowly, taking, it is stated, 48 hours in the case of the subcutaneous site and 24 in that of muscular. This comparatively slow rate of dispersion of the antitoxin, presumably into the blood or lymph streams, is usually held to be a disadvantage, and it is largely on this account that the more rapid methods of venous or thecal injection have been advocated as more suitable for treatment in the early or acute stages. To us it appears that this slow rate of absorption should rather be counted as a virtue, especially when the inoculations are made somewhere along the supposed path taken by the toxin in its journey from wound to cord. At all events, it seems clear that by these methods we could in a given area produce a zone of tissue bathed in antitoxin in far higher concentration than could be produced in the blood and lymph of the part by means of intravenous injections, except perhaps by immense doses frequently repeated. Further, it is probable that this antitoxin would remain available locally in considerable strength for a number of hours. On the other hand, assuming that antitoxin is absorbed from the muscles with comparative rapidity, this would be a reason for utilising that channel in order to reach the nerve-centres rapidly, through the general circulation, in cases where it was hoped to effect an early dissociation of toxin from these centres.

Should the wound be a single one, and especially if it is on a limb, we believe it would be sound practice to introduce antitoxin, both subcutaneously and intramuscularly, somewhere astride the path which the toxin must travel on its way to the spinal cord. To do this effectually it would appear, if our ideas are correct, better to divide the dose and inject portions on each surface of the limb and also at different depths amid the muscles. Somewhere among these tissues we know the nerves run along which the poison is travelling, and the more evenly distributed our antitoxin the better would appear the chance that it may attain effective contact with the toxin and achieve our object.

We have already mentioned that the results of these two methods of introducing antitoxin appear, in the present series of cases, to have been better than those of either the intrathecal or the intravenous methods. It may be that they would have been better still if employed alone and on the lines suggested above.

Turning now to the question of dosage this appears a most difficult matter to judge. Cases recover in which the amount given has been almost ludicrously small, and others have died in spite of enormous doses. It appears to be a question of bringing the antitoxin into effective contact with the toxin. There can be no conceivable benefit in flooding the body fluids with antitoxin if this never reaches the site where it is required, and, on the other hand, quite a small dose might, by acting at the right time and in the right place, do all that was needed. There are obvious limits to the amount which one can inject intrathecally, but none by the other routes. On the whole, while admitting that we have little to guide us in the matter, we think that, if the combined subcutaneous and intramuscular routes be used, the daily dosage for the first few days should not fall below 10,000 units. If it be desired to supplement this by intrathecal injections it would appear wise to limit these to such a number of units as could be contained in 10 or 15 c.c.

We are in full agreement with all that has been said on the necessity for commencing specific treatment at the earliest possible moment and also on maintaining an effective dosage well into convalescence. The present series contained several examples of relapses occurring on the cessation of serum treatment. With regard to the recommendations of the Tetanus Committee as to watch being kept for early signs of tetanus, this is obviously of the first importance. In connexion with the present series of cases we have unfortunately received little fresh information on this point. A statement upon this point is now asked in every case, but so far has brought little to light. Practically the only early sign mentioned has been that of local contractures at or near the wound, and this has usually been followed rapidly by trismus. Some of the signs mentioned by the committee, such as pain in the wound and hardness of the tissues surrounding it, are, we fear, too common in connexion with sepsis, gas infection, &c., to possess as much value here as they might at home.

With the recommendations of the committee on the subject of repeating the initial prophylactic dose of antitoxin every six or seven days as long as there is any reason to fear tetanus, we are, we need hardly add, in the fullest accord. Instructions on this have been circulated to all concerned. Again, we agree that a preventive dose should be given prior to any secondary operation. For the reasons given above we think that it would be well to give such a dose by the combined subcutaneous and intramuscular channels, inoculating it at several points around the site of operation and at different depths of muscle on its proximal side. If time permitted this should be commenced 48 hours before the operation, but if the operation was one of urgency similar injections in the neighbourhood of the operation wound, with perhaps injection into the sheaths of prominent nerves, would appear a wise routine procedure. As far as present knowledge goes, 1500 units would be a suitable amount to give.

NON-SPECIFIC TREATMENT.

Although really outside the purpose of the present article, we may conclude with a few remarks on the replies which have reached us in connexion with this subject. Carbolic acid treatment has been almost abandoned, and few retain any faith in it. Its use was recorded in 8 cases, in strengths varying from 1–20 to 1–100. In no instance were any remarks made on its favourable influence upon the progress of the case. Magnesium sulphate also has gone out of favour, only 4 cases having been treated by this in July and 2 in September. The intrathecal route was

most often adopted. Some temporary amelioration of the symptoms and control of spasm was mentioned in 2 cases, but paralysis of the legs, lasting 24 hours, was noted in another.

Sedative drugs have been used in the great majority of cases. In order of frequency these were as follows: Chloral, bromide, morphia, chloretone, atropine, omnopon, scopolamine, alcohol, chloroform, and paraldehyde. In some cases, though but few, it was noted that one or other of these drugs had been useful in controlling spasm.

Although fully sympathising with the natural desire of the busy reader to find at the end of a paper such as this a series of "conclusions," we have abstained from them, being very conscious that we have much more to learn on every point under discussion. However, we have not hesitated to express our own views on a number of these points as we have dealt with them, and we trust that they may at least serve to rouse further interest in the specific treatment of tetanus, which we believe to be of greatest value, did we but know how to apply it aright.

MODIFIED TETANUS.

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THERE are two reasons why the subject of tetanus should be of interest at the present moment. In the first place, the disease still occurs amongst the wounded. During the months of July, August, and September, 1916, at the —— General Hospital we had one case of tetanus in every 600 cases of gunshot wound. And this, of course, does not represent the full liability, for cases have occurred in patients who have been evacuated to England, and possibly at casualty clearing stations also. In the second place, a large proportion of the cases which have been seen recently have been abnormal in character, inasmuch as the muscular spasms have not become general. They have remained localised to the muscles in the neighbourhood of the original wound. Moreover, apart from the restriction of symptoms to the muscles in the vicinity of the wound, there are certain other characters which differentiate local or modified tetanus from the natural variety. These will receive attention later. In the meantime it may be remarked that in local or modified tetanus we have a new form of disease. The earliest record of a case[1] is now little more than three years old. The disease is new because its cause is new, for local tetanus is tetanus modified by the prophylactic use of antitetanus serum.

Forms of modified tetanus.—Cases of modified tetanus may be considered in three groups[2]—namely: (1) splanchnic tetanus; (2) cephalic tetanus; (3) local tetanus of the limbs. In all of these forms general spasms with opisthotonos are absent. Cases have been recorded which do not fall into any of these groups—for example, tetanus localised to the abdominal muscles. Nevertheless, these three groups will cover most of the ground and will provide sufficient material for discussion.

1. *Splanchnic Tetanus.*

Splanchnic tetanus[3] follows upon lesions of the viscera—that is to say, penetrating wounds of the abdomen and thorax. It is nearly always fatal and the course is exceedingly rapid, so that death ensues within 24 or 48 hours from the onset of symptoms. Opisthotonos and general convulsions do not occur, the spasms being limited to the muscles of deglutition and respiration. The difficulty in swallowing is a pronounced feature, and may be so severe that the case resembles one of hydrophobia, in which case the sight, or even the mere mention, of a glass of water causes the severest pharyngeal spasm, accompanied usually by acute dyspnœa.

2. *Cephalic Tetanus.*

Of head tetanus there are four varieties: (1) Non-paralytic; (2) the form accompanied by facial paralysis; (3) that accompanied by oculomotor paralysis; and (4) a form in which paralysis of the hypoglossal nerves is a special feature. Of these, the non-paralytic form is said to be the least common,[4] some motor paralysis being the rule in cases of head tetanus. And, as may be expected from its relatively wide distribution, the facial nerve is the nerve that is most commonly affected.

Head tetanus with facial paralysis.—This variety follows a wound of the face or its close neighbourhood, and is characterised by: (1) Unilateral trismus, which may become bilateral, and later on (2) difficulty in swallowing; (3) facial paralysis on the same side as the wound. The most remarkable feature is the fact that spasms occur in the paralysed muscles of the face. The explanation of this phenomenon is that there is an alteration in the conductivity of the peripheral branches of the facial nerve, which results in a partial nerve-block, sufficient to prevent the passage of voluntary impulses but insufficient to block the more powerful and pathological impulses of tetanus. The facial paralysis may persist after the other symptoms have disappeared, but ultimately, as a rule, the face recovers.

Hypoglossal form.—This form appears to be rare. As a matter of fact, in Major Kazanjian's Jaw Clinic there has never been a case, although the wounds treated there are of the kind in which hypoglossal tetanus might be anticipated.

Ophthalmoplegic form.—Ophthalmoplegic tetanus follows wounds of the orbit or its immediate neighbourhood. Ptosis is said to be the commonest symptom, but any or all of the ocular muscles, extrinsic or intrinsic, may be paralysed.

3. *Local Tetanus of the Limbs.*

The last abnormal form of tetanus is that which is limited to one or more of the limbs—that is to say, to one arm, or to one leg, or to both legs. These have been described as the monoplegic and paraplegic types. I do not know whether tetanus limited to the two upper extremities ever occurs. And as regards the simultaneous affection of one arm and one leg—a hemiplegic form—it is difficult to see how this could come about except as the result of simultaneous lesions of these two members.

The chief symptoms of local tetanus are clonic and tonic spasms of the wounded limbs. The clonic spasms have been described in some of the recorded cases as being accompanied by considerable pain, and as lasting for four seconds. As a matter of fact, in the four cases we have had at the —— General Hospital the clonic movements have been painless and have been mere twitchings, lasting, perhaps, for half a second each. In three out of the four cases these twitchings were the first symptoms to be noticed, while in the fourth case the patient complained that his arm was stiff, and it was found that spasticity and twitchings were both present. In the two cases which survived the twitchings gradually became less frequent with the passage of time, while the spasticity became more pronounced and showed no sign of passing off so long as the patients remained under our observation.

Tetanic spasticity.—In the two fatal cases no tonic spasm at all was observed. It is quite possible that in some cases twitchings may not occur, or may escape observation, and the spasticity may then be the only material result of the tetanus. And unless attention be directed to this possibility, it is likely that the true cause of the tetanic spasticity may be overlooked, while in some recorded cases the tonic spasm has preceded the twitchings, and from these facts it is recommended that "persistent hardness in a recently wounded limb should suggest tetanus." The most likely error is to mistake tetanic rigidity for hysterical spasm, which it closely resembles. But in this connexion it is to be noted that tetanic spasticity does not pass off during sleep—at least it did not so pass off in our cases.

There is a special reflex which is indicative of tetanus, and which may be of help in diagnosing certain cases. This reflex consists of extension of the foot and leg when the sole is stimulated, and is in contrast with the normal reflex, which is a withdrawal of the foot from the stimulus. The knee is placed is a position of slight flexion while the stimulus is applied to the sole. There is another sign which Lieutenant B. S. Simmonds has pointed out, and which is elicited as follows: Suppose the leg to be affected; light touches, even the lightest with a wisp of cotton-wool, will produce reflex spasms in that leg. To bring about the spasm by stimulating the thigh, a more vigorous application is necessary; for example, tapping the skin with the fingers. And the further away from the affected part that the stimulus is applied, the more vigorous must it be to evoke reflex spasms. I have thought that respiration of automatic type is an early sign, and believe that it may precede even trismus, and be the first positively recognisable evidence of the onset of tetanus.

Post-tetanic anæsthesia.—In the two non-fatal cases of local tetanus of the limbs which we have had at the —— General Hospital areas of cutaneous anæsthesia remained. The question arises as to whether this anæsthesia is a consequence of the disease apart from gross trauma of the peripheral nerves. In our cases, the wounds were deep wounds and the cutaneous anæsthesia may have been due to direct injury of a nerve in the wound area. This important point can be cleared up only by further careful observation of cases of local limb tetanus when direct injury of nerves supplying anæsthetic areas can be excluded.

Notes of Cases.

The following brief notes on the cases of abnormal tetanus which we have had at the —— General Hospital may be of interest. They are six in number, and include one case of splanchnic tetanus, one of head tetanus, and four of tetanus localised to the limbs.

CASE 1. *Splanchnic tetanus.*—The patient was an officer who had been wounded on Sept. 15th in the abdomen. Laparotomy had been performed and some perforations of the small intestines had been sutured. 500 units of antitetanus serum had been administered. We admitted him on Sept. 23rd, when the abdominal wound was cleanly healed. Three days later, 11 days after receipt of the wound, at 5 P.M. he complained of having a stiff jaw. Definite trismus was present and pharyngeal spasm was a pronounced feature. He rapidly became worse and died at 1.30 next morning—that is to say, 8½ hours after the first symptoms had been noted. He had no opisthotonos or general spasms. Death was preceded by unconsciousness and stertorous breathing.

CASE 2. *Cephalic tetanus.*—The patient was wounded on Sept. 25th by a fragment of shell, which entered his face just above the left temporo-maxillary joint, penetrated the temporal bone, and passed upward into the temporo-sphenoidal lobe of his brain. On admission he had aphasia and weakness of the right upper extremity. On the 30th his skull was opened and the foreign body was extracted. Six days later—that is to say, 11 days after being wounded—tetanus developed. 750 units of antitetanus serum had been given to him at the casualty clearing station shortly after the receipt of his wound. The first symptoms were clonic spasm of the left facial muscles and trismus. On the following day there were added to the facial spasms incessant masticatory movements of the lower jaw and lips, in the course of which his tongue was severely bitten. It was thought—the patient thought so himself—that his tongue took part in the spasmodic movements. Two days later he had left facial paralysis, with spasms of both sides of the face, those on the right side being most vigorous. The left sterno-mastoid had become spasmodic also. On Oct. 22nd, 16 days after the onset of symptoms, the spasms ceased, but left facial paralysis remained.

Local tetanus of the limbs.—The four following cases are examples of local tetanus of the limbs:—

CASE 3.—Patient was wounded in right hip on July 1st. On the 5th the wound was freely opened and a fragment of shell removed. On the 8th, seven days after the wound had been received, twitchings commenced in the right lower limb, and soon involved, though to a lesser extent, the left lower limb. Two days later the patient's pulse became weak, he became unconscious, and died. The twitchings, which were painless, continued up to the time of death, but they remained localised to the lower extremities, and he never had trismus, opisthotonos or spasms, other than those affecting the two lower limbs.

CASE 4.—Patient was admitted on July 4th with a gunshot wound of the left knee, penetrating the joint. The knee-joint was septic, and was treated by incisions and fixation. He had been given antitetanus serum before his admission. On July 10th twitching began in the left leg and foot. On the following day the right leg and foot were also involved, and amputation was performed through the left thigh. Three days later the patient died. Since the amputation the twitchings had continued in the right foot and leg. He never had any trismus or opisthotonos.

CASE 5.—An officer had been wounded slightly in the face on July 1st, and had been given antitetanus serum on the following day. He was again wounded by fragments of shell in the calf of the left leg and the left thigh ten days later. On this occasion no serum was given. On the 25th, 14 days after the second wound, the left foot and leg began to twitch. During the spasm there was plantar flexion of the foot, dorsal flexion of the toes, and flexion of the knee. The twitchings were painless. Gradually the affected muscles became spastic, so that a week after the onset they no longer became relaxed between the spasms. The twitchings, as time went by, became less obvious, until they were no longer noticeable, but the tetanic rigidity remained unaltered up to the time of the patient's evacuation to England on Sept. 9th, three months after the receipt of his wound. There was anæsthesia to light touch of the heel and inner side of the foot.

CASE 6.—This patient is the subject of the illustrations. (See figures.) He had been wounded on July 23rd in the face and back, where there was an entry wound at the vertebral end of the spine of the right scapula. There was no exit wound. He had been given antitetanus serum on the day following the receipt of his wound. On August 14th, 22 days after being wounded, he complained of stiffness of the right arm, which was then observed to be twitching and to be spastic, with the arm slightly abducted from the trunk and the elbow flexed. The spasm could be overcome by steady traction until the arm was fully extended without causing the patient any pain, but as soon as the traction ceased the arm resumed its spasmodic position. In the course of the next few days the right trapezius and sterno-mastoid were observed to be twitching and to be tonically contracted also, causing elevation of the right shoulder and flexion of the right side of his neck. The twitchings were last noticed on Sept. 6th, but the tetanic rigidity remained undiminished up to the time of the patient's evacuation to England. Throughout there was cutaneous anæsthesia to pin-pricks and light touch over the area of distribution of the fourth cervical nerve.

Photographs of a Patient Illustrating Tetanic Spasticity.

Front view.

Back view.

Incubation period.—The incubation period in the fatal cases varied from 6 to 11 days, the average being 8 days. In the non-fatal cases the incubation period varied from 11 to 22 days, the average being 16, so that the prognostic significance of a short incubation period appears to be identical in local and general tetanus—that is to say, so far as these few cases indicate.

Duration.—The duration of the disease in the cases which recovered, estimated by the period during which twitchings were observed, was between three and four weeks. It is difficult to be more exact, because the twitchings did not suddenly cease; they gradually became less frequent, less easily evoked, and less violent, so that their final disappearance was not a striking event to which a definite date could be affixed. The tonic spasm continued unabated so long as the patients were under our care.

Mortality.—The mortality was 50 per cent. This seems a peculiar fact, especially so inasmuch as the patients did not die of exhaustion from general spasm or from respiratory spasm. Presumably they did not die of sepsis in the ordinary sense of the term, for one had a clean amputation stump, and another had a healed abdominal wound, as the only source from which such septic absorption could have been derived. On the whole, it seems probable that the cause of death was tetanus toxæmia, causing a medullary paralysis, though I have not seen any previous reference to this mode of death from tetanus.

Theoretical Considerations.

In discussing the subject of local tetanus a great many points of interest will arise. For local tetanus, as has been

stated already, is a new form of disease. It is tetanus modified by the prophylactic injection of antitetanus serum. And it is the general adoption of this prophylactic treatment that has given us the opportunity to study the conditions. Cases of tetanus beginning locally and followed by trismus and general spasms have long been described, but pure local tetanus is a new thing so far as man is concerned. It is not unknown in animals. In the cat, which is relatively insusceptible to tetanus, a sub-fatal dose of tetanus toxin produces a persistent tonic spasm of the injected limb, and nothing else. And the same is true of the guinea-pig, if the dose of toxin be immediately followed by a sufficient dose of antitoxin. From which facts we may assume that the localisation of tetanus in man, as in the cat and guinea-pig in these experiments, is due to the presence of tetanus antitoxin in the blood.

We have still to consider why, with antitoxin circulating in the blood, there should develop any tetanus at all, and the solution of this question has been provided by experiments on animals. These experiments show that there are two avenues of approach whereby the toxin of tetanus may gain access to the central nervous system. These two avenues are: (1) The general blood stream; (2) the motor nerves. If both these avenues are open general tetanus will ensue. If both are closed, there will be no tetanus. If No. 1 is closed while No. 2 in open, local tetanus will result. Further, the route by the general blood stream is more easily barred than is that by the motor nerves. For toxin circulating in the general blood stream is readily neutralised by antitoxin present in the same medium, whereas the toxin, once it has gained entrance to a motor nerve, is almost insusceptible to the neutralising action of antitoxin. And it has been shown also, that when tetanus toxin is injected into a muscle, its passage into the nerve is rapid, so rapid that it may forestall the antitoxin and bring about local tetanus. Incidentally, it would seem that local tetanus is not likely to occur at all unless there is direct injury of muscle tissue—that is to say, if the hypothesis of causation is correct, local tetanus is unlikely to follow, for example, a wound involving skin and subcutaneous tissue only. Observations on this point are desirable.

Some hold [6] that the peripheral nerves are the sole means of entry of tetanus toxin to the central nervous system, and they explain the absence of generalised tetanus after subcutaneous administration of antitetanus serum as due to immunisation of the higher centres thereby, this immunisation being insufficient to overcome the relatively concentrated attack on the cord at the place of origin of the motor nerves. So far as treatment is concerned, it is immaterial whether this or the foregoing hypothesis is the correct one.

Can Tetanus following Gunshot Wound be Abolished?

General experience has shown that a great diminution in the occurrence of tetanus has followed the systematic use of antitetanus serum in cases of gunshot wound. There is strong evidence that it can be abolished, provided that two conditions are fulfilled. The two conditions are:—

(1) Firstly, that the initial dose of antitetanus serum is given sufficiently soon after the infliction of the wound. It has been shown that once the toxin has entered the motor nerves, or the central nervous system, it is not readily neutralised by antitoxin, and while we may suppose that tetanus bacilli require a little time to become established in a wound and to produce a material amount of poison, it also requires a certain period of time for antitoxin, injected subcutaneously, to produce much effect. It is stated [7] that with subcutaneous injections of tetanus antitoxin, as with similar injections of antidiphtheritic serum, two days are required for a maximum effect.

(2) The second condition is that the dose must be repeated. Tetanus antitoxin does not persist indefinitely in the blood. It disappears rather rapidly—ten days is given as its average time of endurance—and therefore the dose must be repeated at intervals of a week or thereabout, to ensure the maintenance of a proper amount of antitoxin in the blood. For by injecting antitoxin we do not destroy the tetanus bacilli in a wound. These continue to flourish, and to manufacture their toxin in spite of it, and have been found in a vigorous and virulent condition for as long as six weeks after the wound was received [8]

Duration of effect of antitoxin.—Ten days have been given as the period during which a single dose of antitoxin is effective. This, of course, is a general rule only. In the third case of local tetanus (Case 5) the patient had been given a dose of antitoxin nine days before receiving the wound from which modified tetanus developed, and 23 days before the first symptoms appeared. From which it appears that antitoxin in some cases may remain potent in the blood for more than ten days; potent, that is to say, to prevent general tetanus. Perhaps it may last a great deal longer than this, as the following case seems to indicate.

A man was wounded in the foot in November, 1915, and was given antitetanus serum. On July 2nd, 1916, he received slight wounds in the back of his neck. He remained with his battalion, and no serum was given. On Sept. 14th stiffness of the jaws and difficulty of swallowing developed, for which he was treated at a casualty clearing station. These symptoms lasted for about ten days, and then passed off without the development of any grave consequences. Presumably this was a case of modified tetanus, although eight months had elapsed between the injection of antitetanus serum and the receipt of the second wound, and ten months between the injection and the first appearance of symptoms.

I have not included this among our cases of local tetanus, because the chief symptoms had disappeared by the time that we admitted him.

On the other hand, there is clear evidence that not only local but general tetanus may in some instances follow a gunshot wound, in spite of a single prophylactic dose of antitetanus serum.

We had such a case in 1915, in which general tetanus developed 21 days after a gunshot wound of the forearm, although a prophylactic dose of antitetanus serum had been administered shortly after the receipt of the wound. This patient, an officer, was a chemist in civil life, and was absolutely sure that an initial prophylactic dose of serum had been given to him.

Site of injection.—Judging from the knowledge gained by experiments on animals, there seems to be some advantage from injecting the serum in the first instance into the muscles of the wounded limb. This certainly seems to be advisable in cases where, for any reason, delay has come about in giving the initial dose; for example, in the case of a wounded man who has lain out for some days after being wounded.

Treatment of Established Tetanus.

In a case of established tetanus we must remember that, although the symptoms are local at first, they may become general. And, therefore, for purposes of treatment we cannot always differentiate between local and general tetanus, and we are not likely to be wrong if we assume that the patient is threatened with the greater evil. And this is so, even though it be stated on the patient's field medical card, that antitetanus serum has been given. For the administration of these prophylactic doses is often carried out by others than qualified medical men, a circumstance which is unavoidable, and yet carries with it the possibility of technical error. Moreover, as shown above, general tetanus may sometimes follow in spite of the proved use of prophylactic treatment.

The indications are: 1. To neutralise the toxin which is present in the circulating blood. 2. To neutralise the toxin which is passing into the nerves of the injured part. 3. To neutralise as soon as possible the toxin which has already reached the central nervous system.

Subcutaneous injection is too slow in its action to effect any of these objects, for speed is of urgent importance, and if no time is to be lost at all it will be necessary to employ three methods of introduction—namely, (1) intravenous; (2) intramuscular, i.e., into the muscles of the affected limb; (3) intrathecal. A suitable treatment would be the immediate intravenous injection of 3000 units of antitetanus serum, accompanied by the introduction of similar amounts into the spinal theca and muscles of the affected limb.

Anaphylaxis.

What dangers are to be feared from anaphylaxis? Personally, I believe that unless precautions are taken there is a real danger—in the case of intravenous injections, at any rate, of causing anaphylactic shock by secondary doses. I believe cases of sudden death to be examples of anaphylactic shock and to indicate that the secondary injection of antitoxin into a vein, in the presence of anaphylaxis, is a dangerous procedure unless certain precautions be taken.

Recognition of anaphylaxis.—How can we know if anaphylaxis is present? We can assume its presence if the patient has had a dose of serum ten or more days previously. As to the length of time during which anaphylaxis will continue there seems to be no definite information. Nevertheless, as anaphylaxis is present in some individuals to whom no serum has been administered previously, it is necessary to take special precautions in all cases in which the intravenous route is used for the injection.

By the following method danger from anaphylactic shock is said to be avoided.[9] 5 c.c. of antitoxic serum are diluted with 50 c.c. of warm saline. 1 c.c. of this is run into a vein. 4 minutes later 3 c.c. are run in; 2 minutes later 10 c.c., and 2 minutes later again 25 c.c. are run in, and after a pause of 10 minutes the remainder is injected. After this the intrathecal and intramuscular injections may be made without further special precaution against anaphylactic shock.

For some hours following the performance of intrathecal injection of antitetanus serum it is necessary, of course, to keep the foot of the patient's bed well raised. We know, from experience with spinal anæsthesia, that fluid injected into the lower portion of the spinal theca will not travel up the cord if the patient's dorsal spine be raised above the level of his lumbar spine. We also know that the fluid will travel up if the foot of the bed be raised. And what is true for a solution of novocain we may assume to be true of a solution of tetanus antitoxin.

Besides the administration of antitetanus serum, other therapeutic measures need consideration. Of drugs, chloral, bromide, and morphia have been the most used. For procuring rest paraldehyde in large doses has seemed of great benefit, and is perhaps more effective than any other drug. In severe cases a watch must be kept for acidosis, which is said to be present, as might be expected, in most of these.[10]

Treatment of the wound also is of importance. The natural impulse is to operate at once in order to eradicate the offensive bacilli, to excise necrotic tissue, to remove foreign bodies, and to provide free drainage; or to amputate the limb, but caution is required here, for experience has shown that operations on wounds infected with tetanus bacilli are likely to bring about a sudden diffusion of toxin, with consequent disaster. And the same is true of amputation, even though the amputation be performed before tetanus has declared itself. Operations, therefore, should be deferred, if possible, in all cases of established tetanus until sufficient time has passed for artificial immunisation to have been effected.

Immobilisation, however, so far as this is possible, is of paramount importance. We know the ill-effect of movement in the case of wounds infected with tuberculosis or the organisms of sepsis, an effect which consists of diffusion of toxins and possibly of bacteria also. A similar effect ensues in the case of wounds infected with the bacilli of tetanus. And not only the wound but the patient also, so far as is possible, must be kept at rest. In general illustration of this point may be quoted a case that we had in 1915.

The patient, an officer, had passed successfully through an attack of general tetanus. After the symptoms had subsided and we regarded him as cured he was evacuated to England. On his arrival there tetanus again developed, and he underwent a second attack, brought on, there is little doubt, by the disturbances of his long journey.

Conclusion.

In conclusion, I should like to ask the following open questions:—

1. What cases of modified tetanus have been met with?
2. What have been the special features?
3. Have areas of cutaneous anæsthesia been observed in these cases?
4. Has persistent tetanic rigidity been present?
5. What is the cause of death in fatal cases?
6. Have any cases of anaphylactic shock been observed, and, if so, in what circumstances?
7. Have any cases of sensory tetanus been observed?

Answers to these questions I hope will be forthcoming, and also a great deal of other information on this interesting subject of local tetanus. If we are to understand the condition thoroughly, we must learn about it now, while there are cases available for study. It is to be hoped, therefore, that medical men who have had cases under their care will forthwith publish the details, and so communicate to others the benefit of their own experiences.

Continued at foot of next column.

WEIL'S DISEASE (SPIROCHÆTOSIS ICTERO-HÆMORRHAGICA) IN THE BRITISH ARMY IN FLANDERS.*

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A SHORT preliminary note[1] on infectious jaundice among British troops in France was written in the early summer of 1916. Although the investigation of this disease is still being pursued both here and elsewhere and is as yet far from complete, the accumulation of considerably more material, both clinical and experimental, since our last publication would seem to justify a further communication at the present moment. The additional results which we have attained contain little not already described by Inada and his collaborators, but they seem of interest in that our confirmation of the findings of the Japanese workers, at the time of our first note only partial, has now been rendered almost complete. The only results which we have not been able to duplicate are their success in growing the causal organism in artificial culture and the finding of spirochætæ in the urine. The possible explanation of the former point and the evident explanation of the latter are discussed below.

Previous Work.

The disease commonly bears the name of Weil, who described it in 1886, but Martin and Pettit, in a recent publication discussed below, point out that this is quite unjust in that several French authors, quoted from Kelsch (1894), had previously described the condition under various names, and at dates extending from the siege of Cairo down to 1886. Those quoted are: Larrey, Ozanam (1849), Monneret (1859), Laveran the elder (1865), Lancereaux (1882), Landouzy (1882), and Mathieu (1886).

Weil described the chief characteristics of the disease as being jaundice, pyrexia, and hæmorrhages, and the occurrence of cases in epidemics or localised groups. Widespread epidemics have been recorded in the United States, and also outbreaks in India, Africa, and the Near East. In Osler's Medicine we find:—

> The symptoms are at first gastric, then fever follows (with the usual concomitants) and jaundice, which may be slight or very intense, and, as a rule, albuminuria. The liver and spleen are often enlarged, and in the severe forms there are nervous symptoms and hæmorrhages. There is often a secondary fever, and the attacks last from ten days to three weeks. The course is usually favourable; fatal cases are rare in the United States and in India and South Africa, but in the Greek hospital at Alexandria the death-rate was 32 among 300.

No definite etiology had been established until the subject of infectious jaundice was reopened by a monograph from Drs. Inada, Ido, Oki, Kaneko, and Ito, which was first published in the English language in March, 1916, in the *Journal of Experimental Medicine*. In this paper the authors state:—

> In the western part of Japan there prevails an epidemic and endemic disease, characterised by conjunctival congestion, muscular pains, fever, jaundice, hæmorrhagic diathesis and albuminuria, which is known as Weil's disease or febrile jaundice. At the end of last year (1914) the same disease was observed in Shiba, in the eastern part of Japan near Tokio, where the patients numbered 178.

* Received for publication on Dec. 8th, 1916.

[1] Journal of the R.A.M.C., September, 1916, and Brit. Med. Jour., Sept. 23rd, 1916.

Continued from preceding column.

References.—Montais and Broch: Annales de l'Institut Pasteur, July, 1916, quoted in THE LANCET, 1916, ii., 834. 2. Courtois-Suffit and Giroux: Les Formes Anormales du Tétanos, 1916. 3. Loc. cit. 4. Loc. cit. 5. Montais and Broch: Loc. cit. 6. Burnet and Tulloch: Brit. Jour. Surg., July, 1915. 7. Browning: Brit. Jour. Surg., July, 1916. 8. Robertson: Lister Institute, Nov. 23rd, 1916. 9. Browning: Loc. cit. 10. Embleton: Trans. Med. Soc., Lond., xxxviii.

In 1914 Inada and Ito reported the discovery of a spirochæta in the liver of a guinea-pig which had been injected with the blood of a patient suffering from Weil's disease. They reported that they were able to repeat this finding with the blood of other cases, the animals developing albuminuria, pyrexia, and jaundice, and they were able to show the spirochætæ in the liver and blood of the animals in large numbers. They were able to pass the infection from animal to animal, and in one strain they had reached 50 passages. The experiments made with the blood of normal people and of patients with catarrhal jaundice produced no such result. Subsequently the Japanese workers were able to demonstrate "the same spirochætæ in six specimens of patients' blood, in the intestinal wall of one case, and in the adrenal gland of another case, of 11 autopsied cases." In two cases which came to autopsy on the sixth day of illness they found the spirochætæ in the liver in almost as great numbers as in the liver of guinea-pigs. Finally they showed that the blood serum of patients recovering from the disease contained protective substances against the spirochætæ.

From these data they came to the justifiable conclusion that the spirochæta which they had found was to be considered the causal organism of the disease. They state that they have, with the blood of 13 out of a series of 17 cases, succeeded in producing the disease in guinea-pigs, the animal showing the typical signs of the disease and the spirochætæ being found in the blood and liver. The blood from all cases in which it was taken on the fourth or fifth day of illness gave positive results, but after the fifth day the results became more inconstant as the disease progressed. They indicate that the spirochætæ disappear from the blood coincidently with the appearance of immune substances in the serum. In the early stages the spirochætæ were in the blood stream, but as the disease progressed they disappeared from the blood, and the authors were not able to demonstrate them in the tissues. At some period after the tenth day spirochætæ appear in the urine and may be demonstrated both by dark-ground illumination and by animal inoculation. They consider the appearance of the spirochætæ in the urine to depend on the development of an immune substance in the serum. They have been able to find spirochætæ in the urine as late as the thirtieth day.

Weil believed that the entry of the infection was through the alimentary canal, and Inada supports this view. Ido and Oki have noticed that the disease sometimes begins with a local swelling of the lymph glands, and, further, they have been able to communicate the disease to animals by applying infected material to the uninjured skin. This led them to think that there was a possibility of infection occurring through the skin. In support of this view they note that the disease was more frequent in the wet parts of certain mines, and that, the water having been pumped out on their suggestion, no further cases occurred in those particular areas. They also noted that there were more cases in wet mines than in dry, and that men working on the surface did not contract the disease. They think from clinical observation that direct infection from man to man is rare. Without stating their reasons they say that they consider transmission by mosquitoes or by vermin unlikely.

In the *Bulletin de l'Académie de Médecine*, Oct. 10th, 1916, Dr. L. Martin and Dr. A. Pettit have published an interesting note confirming the existence of the disease in the French Army. They have followed two cases in full and succeeded in finding the spirochætæ in the urine and in infecting with the urine of patients convalescent from the disease. They further add an important link to the epidemiology of the disease in describing a most interesting case of one of their colleagues, who himself became infected in passing the disease from animal to animal, the circumstances leaving no doubt that the period of incubation was six to eight days.

General Clinical Picture of the Disease.

Our attention was first called to the disease by a fatal case of jaundice under the care of Captain Flood, R.A.M.C., whose permission we have for mentioning the case.

The man was admitted with a temperature of 105° F. and very deep jaundice. On the evening of admission there was severe epistaxis, which necessitated the plugging of the nares. Hæmorrhagic diarrhœa set in, and on the third day after admission the trunk and limbs were covered with petechiæ. Death followed on the next day. Multiple hæmorrhages in the pleuræ, pericardium, and peritoneum were the most striking feature, apart from the extreme jaundice of all the viscera. The bile passages were free and the duodenum normal. This is the only case we have seen in which the generalised hæmorrhages occurred in more than trivial degree, and in this case hæmorrhagic diarrhœa was apparently the immediate cause of death. At the time there were no guinea-pigs available for inoculation and the tissues from the case were unfortunately lost. An emulsion of the liver and kidney examined by dark-ground illumination revealed no spirochætæ.

A second case, also fatal, occurred a few days later; the patient was admitted moribund under the care of Major Young, C.A.M.C., and died within a few hours. The autopsy showed nothing significant with the exception of the extreme jaundice of the viscera and advanced hæmorrhagic nephritis. Tissues examined for us by Dr. Laidlaw at Guy's Hospital did not reveal any spirochætæ, and this is in accordance with the findings of the Japanese workers who state that it is very difficult to find the spirochætæ when the patient dies late in the disease, as happened in this case which terminated on the twelfth day.

Since then about 100 cases have been observed by us, and of these 50 have been under the personal care of one of us (J. A. R.). In 26 cases we have infected animals from the patients. The animals have died or have been killed, and have all shown the characteristic picture of the disease in the animal, and we have been able to find the spirochætæ in all of them, either in films or sections of the tissues. Early in our observations we were struck by the occurrence of cases showing a similar clinical picture, but no jaundice, and we have since been able to establish the fact that cases of spirochætosis occur without external signs of jaundice, which would seem to cast a doubt on the accuracy of the terms epidemic jaundice and spirochætosis icterohæmorrhagica. We cannot say definitely in how many cases of Weil's disease jaundice occurs as a clinical sign, but we estimate that it does not occur in more than 60 per cent. of cases in the epidemic with which we are dealing.

The onset.—The history of onset was strikingly uniform, and the acuteness of the inception of the disease may be judged from the fact that the patients almost invariably were able to date the onset by some simple reference to the duty they were performing at the time. The onset is very commonly heralded by a shivering fit and a feeling of faintness or giddiness. Characteristic early symptoms have been vomiting, headache, and pains in the back and limbs. The patients complain of great weakness and of feeling as if they had been beaten all over, and they are so sensitive to these pains that they are reluctant to move their limbs or to turn over in bed. Pain in the eyes is a frequent early symptom, and there are often vague unlocalised abdominal pains. The onset is generally with fever of a more or less high degree, varying between 103° and 105° F. The limb pains appear to be muscular, but in one case were especially referred to the tibiæ. All the patients on admission were very weak and often collapsed, and complained of the early feeling of unsteadiness and inability to stand.

Alimentary system.—The tongue is excessively dry, brown in colour, frequently fissured, and there are sordes on the lips. Herpes labialis, invariably becoming hæmorrhagic, occurred in 42 per cent. of cases. Vomiting in the early stages may be said to be a constant symptom; it often persists for several days, and the vomitus is frequently bilious. A history of blood in the vomitus is occasionally elicited, and streaks of blood have been seen, but as this may have been swallowed from the naso-pharynx it was not noted as a true hæmatemesis. Appetite, which was lost during the pyrexial period, returned as the jaundice faded. Hiccough occurred in the two most severe cases, one of which terminated fatally.

Except in two cases, in which there was a history of initial diarrhœa, extreme constipation was the rule throughout the acute stage of the disease. The stools were usually bile-stained. One fatal case succumbed to a terminal hæmorrhagic diarrhœa, and in one other small traces of blood were observed in the stools. Intestinal hæmorrhages may therefore be regarded as exceptional. During the first few days many patients complained of vague abdominal discomfort and pain, but there was never any localised tenderness. Abdominal examination revealed distinct hepatic enlargement in one case without jaundice, but in no other case was the liver palpable. The spleen was not palpable in any case while under observation here.

Circulatory system.—The pulse-rate is usually slow in proportion to the temperature, and this holds good even in the cases without jaundice. In one severe case the pulse-rate rose to 120 during the first week. In early convalescence there is a definite diminution in the pulse-rate. Even

in the bad cases the tension and volume are good. Marked dicrotism was once noted. Except in one case in which the apex beat was for a short time external to the nipple line, there was no clinical evidence of cardiac dilatation.

Respiratory system.—There is, as a rule, no evidence of respiratory complications beyond slight bronchitis in the severer cases or hæmoptysis. The respiratory rate is sometimes raised during the early stages, but there was never any evidence of consolidation or pleurisy. In 26 per cent. of cases there was blood-tinged expectoration. Both "bright-red" and "rusty" sputa were noted, the latter being the more common. In the two cases in which hiccough was noted a peculiar catchy type of inspiration occurred, and in two others there was an expiratory grunt, although no other pneumonic symptoms were present. Epistaxis occurred in 17 per cent. of cases.

Excretory system.—Two cases had difficulty in micturition for which there was no obvious cause. The urine of jaundiced cases contains bile in varying quantities. In some the urine is very deeply coloured, in others the colouration is less evident. In some of the cases without jaundice bile has been demonstrable in the urine. Albuminuria was almost a constant accompaniment of the pyrexial period and varied from a "faint trace" to a "considerable amount." Granular tube casts and red blood cells were present in centrifugalised specimens. Probably as a result of the fever and vomiting acetone was also demonstrable in the urine of all the graver cases.

Nervous system.—Weakness and great prostration are characteristic of the onset of the disease. Headache and generalised pains and stiffness are constant symptoms, and the pains in the back and legs are exceptionally severe, frequently causing sleeplessness. In the graver cases torpor was noticed, and in one fatal case this progressed to the "typhoid state," and was accompanied by rambling delirium, tremors, and muscular twitchings. Pruritus, probably due to the jaundice, occurred in three cases. The eyes are painful and show very marked injection of the conjunctivæ, and in one case during convalescence there was a pink suffused zone round the sclero-corneal junction, associated with photophobia, and suggesting a definite scleritis. Subconjunctival hæmorrhage occurred in one case.

Lymphatic system.—There is a slight enlargement of the glands. The pectoral group of the axillary glands are sometimes felt as discrete shotty nodules on the thoracic wall of the axilla. The cervical glands are also enlarged and sometimes tender. The spleen has never been palpable.

The skin.—Varying degrees of jaundice are seen. The colour is usually of a lemon-yellow to a deep orange tint, and never approaches the greenish colour of obstructive jaundice. It first appears on the fourth or fifth day of illness, occasionally earlier: it becomes progressively deeper until the ninth or tenth day, and then, as a rule, fades very rapidly. In some cases, however, the colouration is more persistent. Of 47 cases diagnosed as Weil's disease clinically, or by communication of the disease to the animal, 74 per cent. have developed jaundice, and 26 per cent. have not shown any colouration.

Hæmorrhagic herpes labialis, occurring in 45 per cent. of cases, was frequently of very wide extent, in some cases covering the chin and upper part of the neck. In one case the herpes formed a black, confluent eruption which completely surrounded the mouth and invaded the nares; the contrast of the black sores with the brilliant orange colour of the facies, together with the blood-shot eyes, gave the patient an alarmingly morbid appearance. Petechial hæmorrhages, widely distributed over the trunk, were present in association with the jaundice in one of our cases which recovered, and in one fatal case under Captain Flood. Profuse urticaria occurred in one of our cases.

The fever.—There is an irregular pyrexia descending by lysis, and ranging for the first week between 100° and 103°. Temperatures of 104° and over are common at the onset. The fever terminates between the tenth and fourteenth days, and is often succeeded by a subnormal temperature for three or four days. In four cases there was a relapse of the pyrexia but not of the other symptoms, but it must be remembered that the cases are evacuated at an early date, as soon as the pyrexial period is passed, and it may be that relapses occur more commonly than would appear from our observations. We insert some typical charts (Nos. I.–IX.) of jaundiced and non-jaundiced cases.

Differential diagnosis.—There is seldom any difficulty in distinguishing between Weil's disease and other forms of jaundice. The high pyrexia, prostration, and conjunctival congestion, on the one hand, and the absence of any localising symptoms, on the other hand, exclude catarrhal jaundice, gall-stones, and cholecystitis. Jaundice due to typhoid or paratyphoid infections is to some extent excluded by blood culture, which is usually done on admission. In the early stages, however, before the appearance of the jaundice and in the non-icteric cases the diagnosis is more difficult. The combination of pyrexia, herpes, and hæmoptysis has not infrequently resulted in the patient being sent to hospital with the diagnosis of pneumonia, while others have been labelled pulmonary tuberculosis, suspected cerebro-spinal meningitis, and "trench fever." Between severe forms of "trench fever" and non-icteric spirochætosis it is almost impossible to distinguish during the first few days unless the presence of vomiting and albuminuria in the latter and their absence in the former should prove constant.

Prognosis.—During the first two months in which we had cases under observation there were two deaths, and though during the following three months four-fifths of the total cases have passed through there have been no further deaths previous to evacuation as convalescent. We have heard of two cases which were evacuated during the pyrexial period and have succumbed elsewhere. On the whole, the prognosis may be said to be favourable even in the more severe cases. The death-rate is, so far as we know, less than 6 per cent.

Treatment.—The treatment at present is purely symptomatic. Good nursing, unlimited fluids, alkaline draughts, fruit to eat, and the rectal administration of glucose (6 per cent. solution, 1 pint) once or twice daily to cases with vomiting and acetonuria constitute the main elements of treatment in our series. When possible the patients are nursed in the open air with apparent benefit.

Clinical Pathology.

In order to attempt to ascertain if the jaundice was of hæmolytic origin we made daily blood counts in four early cases, the count being done on five successive days from the fifth to the ninth day of illness. We were unable to demonstrate any progressive diminution in the cell count or in the hæmoglobin, and the average of the counts was high. Leucocyte counts in the early cases ranged from 9000 to 10,000 cells per c.mm. Stained films did not show any degeneration forms or polychromatophilia, changes which are easily demonstrated in the infected animal. The coagulation-time was taken by Wright's method and ranged around 3 minutes.

The resistance of the red cells to various concentrations of salt solution was tested, and it was found that in the cases with jaundice the resistance was increased. Hæmolysis began in normal blood in 0·450 per cent. NaCl, and did not commence in patients with jaundice till 0·350 per cent., and was not complete at 0·300 per cent. This was not found to be the case in patients suffering from Weil's disease without jaundice, and by the addition of small traces of bile to normal blood cells it was possible to increase their resistance. The end-point of the hæmolysis was very low, "complete" being reached in 4 cases only at 0·250 per cent., whereas the normal controls were "complete" at 0·300 per cent. Blood cultures for enteric group organisms were made in over 50 cases, and were consistently negative at the end of three days.

We searched diligently in blood films for the spirochætæ, using different methods and staining in different ways. In one case after citrating a large quantity of blood (20 c.c.), and allowing the cells to settle, and then centrifuging the citrated plasma, we found one spirochæta and in confirmation the animal infected with the blood developed jaundice. This blood was taken on the fifth day of the disease. Dr. A. C. Coles examined films from two cases for us by his special method; in one, the films being made on the second day of illness, he was able to find two spirochætæ in six films. In the other case the films were made on the fourth day and no spirochætæ could be found. He has included photographs of the two spirochætæ which he found in the set of photographs he has kindly sent us. We attempted to cultivate the spirochætæ directly from the blood-stream on several occasions from early cases, but with no success.

The urine.—Albuminuria was a constant occurrence in varying degree; some cases showed only a faint trace, and in others there was a considerable quantity. Casts, generally granular, were frequently found, and a few blood cells were almost always present in centrifuged deposits. Bile pigments in the jaundiced cases were present in large amounts; in some of the cases without jaundice bile could be detected and in others it was absent. Acetone in considerable amounts was present in nearly all the severe cases during the pyrexial period. Leucin and tyrosin crystals were not found. We examined the stools of a series of cases for enteric group organisms but were unable to find them.

Morbid Anatomy.

Four cases terminated fatally which we were able to observe:—

Pte. M. Duration of disease unknown, died four days after admission with extreme jaundice and severe hæmor-

rhages. Skin showed multiple petechiæ and very pronounced jaundice of a bright yellow tint. Peritoneum, pericardium, and pleuræ covered with small bright-red hæmorrhages; hæmorrhages in the heart muscle and under the endocardium. Heart soft and flabby. Hæmorrhages in the substance of the lung. Liver normal in size, colour, and consistency. Spleen small. Kidneys enlarged and swollen, with multiple hæmorrhages, and deeply bile-stained. Intestines and bile-passages normal. All the large polypi at the pyloric end, one of which had apparently been bleeding and looked like a large thrombosed pile. The heart was very soft and flabby. Two small hæmorrhages in the mesentery, one in a lymph gland. Duodenum and bile-passages normal. No spirochætæ found in emulsions of liver and kidney by dark-ground illumination.

Pte. E. Died on ninth day. Extreme jaundice of skin, no hæmorrhages. Lungs showed many diffuse, ill-defined hæmorrhagic areas, 1 to 2 cm. across; they were most

CHART I.

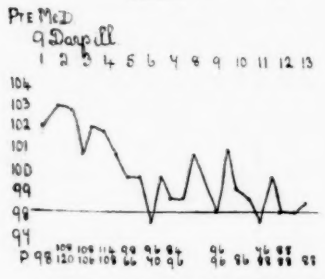


CHART II.

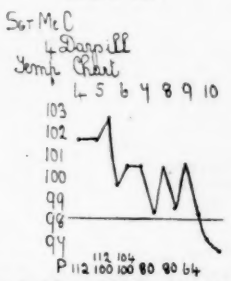


CHART III.

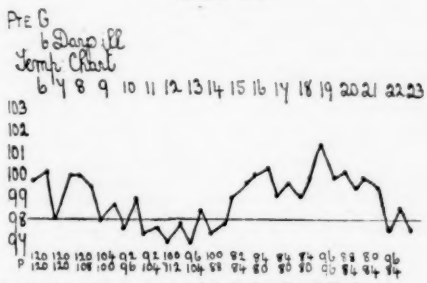


CHART I.—Private McD. Complete chart from first day. History of sudden onset, with shivering, severe pains in head and limbs, jaundice, hæmorrhagic herpes, dry, brown tongue; no enlargement of spleen or liver.

CHART II.—Sergeant McC. Very extensive hæmorrhagic herpes. Jaundice appeared on fifth day. Diagnosed clinically before jaundice appeared. Temperature chart of animal infected from this patient is given later. (See Chart XIII.)

CHART III.—Private G. Chart showing relapse. Vomiting, jaundice, epistaxis, blood stained sputum, and enlarged glands; hiccough severe, drowsiness and torpor. On the tenth day jaundice began to fade. No return of symptoms, with exception of malaise, with recrudescence of pyrexia.

CHART IV.

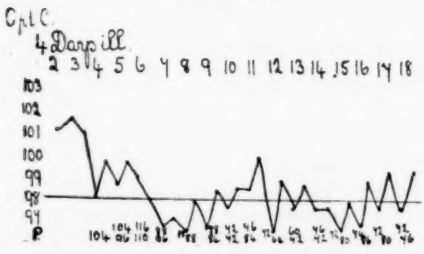


CHART V.

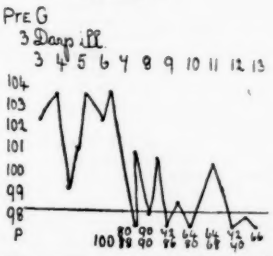


CHART VI.

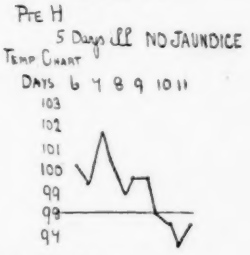


CHART IV.—Corporal C. Chart showing short relapse. Jaundice, herpes, vomiting, epistaxis, albuminuria, acetonuria.

CHART V.—Private G. No jaundice; clinically diagnosed; intense headache, pains in legs and abdomen; liver slightly enlarged and tender; prostration great, injected eyes, albuminuria.

CHART VI.—Private H. Pains in back and legs, injected eyes, drowsiness; no jaundice. Temperature chart of animal infected from this patient is given in the section on the disease in animals. (See Chart XII.)

CHART VII.

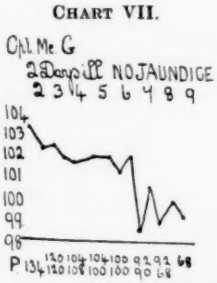


CHART VIII.

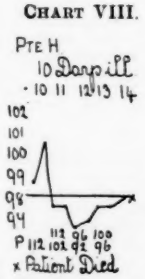


CHART IX.

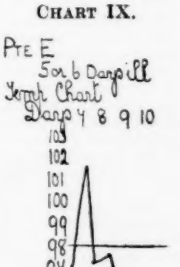


CHART VII.—Corporal McG. Non-jaundiced case. Admitted second day. Severe pains in head, eyes, back, limbs; albuminuria, hæmoptysis, vomiting. Chart of animal infected from this patient given later. (See Chart XI.)

CHART VIII.—Private H. Fatal case. Aged 40. Admitted on tenth day with deep jaundice general malaise, headache, and pains in the legs; onset with vomiting. On admission, conjunctivæ injected, tongue dry and furred; liver and spleen not felt; albuminuria. Twelfth day: Mental confusion, retention of urine, hiccough. Thirteenth day: Rambling delirium, retching, jaundice deeper, pruritus; dyspnœic attack. Fourteenth day; Incontinence of urine and fæces, muscular twitchings. Death supervened.

CHART IX.—Private E. Fatal case. Chart of animal infected from this case is given later. Admitted with jaundice and very ill; unable to give clear account of duration of illness; tongue dry and furred, eyes injected, generalised muscular pains; no enlargement of liver or spleen. Patient given alkaline drinks and 1 pint of 6 per cent. glucose per rectum. Next day patient worse; tremors, restlessness, retention of urine, and feeble, intermittent pulse; 1½ pints of 2 per cent. sodii bicarb. intravenously. Died two hours later, probably on the eighth or ninth day of illness. (See Chart X.)

internal organs, where the colour permitted of its observation, were deeply tinged with bile. No spirochætæ found in liver by dark-ground illumination.

Pte. T. Died on twelfth day. Jaundice somewhat more intense than in the last case. Nothing abnormal noted with the exception of the large, swollen, congested, and hæmorrhagic kidneys. Intestines and bile-passages normal. No spirochætæ found in liver or kidney by dark-ground illumination.

Pte. H. Died on fourteenth day. Deep jaundice of skin and all viscera except the brain. Liver normal in size and colour. Spleen small. Kidneys large, swollen, congested, and showing multiple hæmorrhages. Stomach had two evident on the pleural surfaces, but were also well seen on the cut surface. One small hæmorrhage in the wall of the left ventricle. Heart soft and dilated with deeply bile-stained endocardium. Liver normal in size and colour. Spleen small. Kidneys swollen, enlarged, and showing multiple hæmorrhages. Intestine showed three patches of congestion of the mucosa, one of these in the duodenum. A few enlarged glands in the portal fissure and along the lesser curvature of the stomach. The bile-passages were free.

It will be seen that the hæmorrhages, in varying degree, occurred in three of the four cases. An interesting point is that the brain was not bile-stained, though the cerebro-spinal

fluid was bright yellow. The tissues from two fatal cases are available for study; two other fatal cases occurred, but in one instance the tissues were lost and in the other the tissues were sent home for microscopic examination, and we have no sections now in our possession.

The liver.—(1) Pte. E. (see Chart IX.); (2) Pte. H. (see Chart VIII.). Both livers showed a certain amount of diffuse granular degeneration, though hardly of significant extent. The most evident anatomical change, as seen in Case 1, is an exudation of polymorphonuclear leucocytes in the interstitial tissue surrounding the smaller bile-ducts. The leucocytes are diffusely scattered and nowhere suggest abscess formation, but around a section of small bile-duct 8 or 10 cells in length there may be seen scattered often as many as 12 or 15 leucocytes. They seem to be more numerous around the smallest interlobular ducts. Leucocytes may also be seen here and there between the liver columns, but nearly always within the blood-vessels. The liver (Case 1) shows a very considerable quantity of bile-pigment, mostly within the cells, in the form of greenish-black rods and granular masses. A difference in quantity between different parts of the lobule could not be definitely demonstrated. Bile-pigment was also found in the blood-vessels and in what we take, after some consideration, to be distended intralobular bile capillaries. These are most evident at the periphery of the lobule, in the neighbourhood of the smaller bile-ducts. Thus, a bile-duct may be seen at its origin from the lobule, surrounded by leucocytes, and just within the lobule at this point there may be seen, lying between adjacent liver cells, three or four spaces up to the size of a liver-cell nucleus, distended with bile-pigment, and apparently converging towards the bile-duct. Case 2 shows considerably less interlobular leucocytic exudate and considerably less bile. There is, however, a moderate amount of light-green pigment filling many cells in the form of fine granules. The structures which we take in Case 1 to be distended bile capillaries are much less evident here, although two or three small circular spaces have been seen, each lying between contiguous liver cells and containing a small amount of pigment. Leucocytes are seen in greater numbers than normal, but diffusely scattered between the liver columns and usually between the vessels. Thus, a row of four or five contiguous leucocytes in a small capillary is not difficult to find. Congestion in neither liver is pronounced.

The kidney.—The kidney in each case shows, apart from the acute lesions, a moderately extensive, chronic, diffuse cirrhotic process, rather more pronounced in Case 1. The acute lesions consist in, firstly, swelling and granular degeneration of the tubular epithelium, much more evident in the proximal convoluted tubules and the ascending limbs of Henle's loops. The distribution is diffuse, practically every tubule being involved, so that with most of the tubules the lumen appears to be obliterated. Secondly, a diffuse exudation of polymorphonuclear leucocytes in small numbers, lying between the tubules and more rarely within them. Thirdly, hæmorrhage occurring in poorly defined patches usually involving several tubules. The blood is found mostly within the tubules and widely distending them, particularly in the distal convoluted portion. In both cases there was, however, considerable dilatation due to the chronic process, so it is difficult to decide in how far dilatation due to hæmorrhage occurred. All these changes were more marked in Case 1, where the degeneration of tubular epithelium was extensive. Glomeruli in neither case showed significant changes.

Sections of other organs showed no important changes, with the exception of the localised hæmorrhages in the lungs of Case 1 noted in the gross.

Spirochætæ in human tissue.—Sections of liver, kidney, adrenal gland, and lymph nodes have been prepared by Levaditi's older method and have been thoroughly searched for spirochætæ. We failed to find them in all tissues except the kidney of Case 1. In this kidney a small number of characteristic spirochætæ were found in isolated areas, so that in an entire section they would be found only in the neighbourhood of one glomerulus, but in considerable numbers at that point. They lie very occasionally between the tubules, but the characteristic place is the epithelium or lumen of a proximal convoluted tubule close to its origin from the glomerulus. Thus in one section of a tubule there may be found as many as 10. Where several occur together in this manner, the majority seem to lie near the centre of the tubule among the granular débris. The tubules in which they are found as a rule show more than the average amount of epithelial degeneration.

Experimental Results.

Tables I., II., and III. show the results of the intraperitoneal injection in the guinea-pig of blood of patients clinically diagnosed as Weil's disease. Table I. gives the results from cases showing definite jaundice; Table II. those from cases without evident external jaundice; and Table III. the combined results of the two series.

What we mean by a positive result is that the animal should show the typical signs of the disease, jaundice and hæmorrhages, and that we should find the spirochætæ in the blood or liver, either in films or in Levaditi preparations of the tissues. We have found, as the Japanese workers did, that the intraperitoneal injection of comparatively small quantities of blood gave the most satisfactory results. Various quantities have been tried, but our experience has led us now to employ as a routine a quantity of approximately 3 c.c. Larger quantities have not yielded better results and have often killed the animal on account of the overdose of foreign blood. We have injected as much as 7 c.c. without killing the animal, but there was severe shock and the result was negative.

TABLE I.—*Animals Infected from Cases of Weil's Disease which showed Definite Jaundice.*

Day of disease.	Number of attempts.	Average number of days for death of animal.	Positive.	Negative.	Percentage.
4th	5	10·5	5	—	100
5th	7	10·25	4	3	57
5th or 6th	2	8·5	2	—	100
6th	7	9·75	4	3	57
7th	4	11·5	2	2	50
8th	3	—	—	3	—
9th	2	—	—	2	—
—	30	—	17	13	56·6

TABLE II.—*Animals infected from Patients Clinically Diagnosed as Weil's Disease without Apparent Jaundice.*

Day of disease.	Number of attempts.	Average number of days for death of animal.	Positive.	Negative.	Percentage.
1st*	1	—	—	1	—
2nd	2	8	1	1	50
3rd	1	9	1	—	100
4th	4	9·5	4	—	100
5th	7	8·5	2	5	28·5
6th	4	22	1	3	25
9th	1	—	—	1	—
—	20	—	9	11	45

* No subsequent history of case.

TABLE III.—*Combined Results of the above Two Tables.*

Day of disease.	Number of attempts.	Average number of days for death of animal.	Positive.	Negative.	Percentage.
1st	1	—	—	1	—
2nd	2	8	1	1	50
3rd	1	9	1	0	100
4th	9	10	9	0	100
5th	14	9·37	6	8	42·8
5th or 6th	2	8·5	2	0	100
6th	11	15·8	5	6	45·4
7th	4	11·5	2	2	50
8th	3	—	—	3	—
9th	3	—	—	3	—
—	50	—	26	24	52

The Disease in the Guinea-pig.

The disease in the guinea-pig is characterised by pyrexia, jaundice, prostration in varying degree, and hæmorrhages in the skin, and in nearly all cases where the disease is allowed to take its course a fatal termination. It will be convenient to consider the findings under separate headings.

Incubation period.—The incubation period in guinea-pigs infected with blood from the patient varies within wide limits, and would appear to bear some relationship to the numbers and virulence of the spirochætæ in the blood, and possibly also to the presence of immune substances in the blood. The relationship, however, is not always easy to follow, and apparently contradictory results are often obtained. Tables I., II., and III. show the average number of days from injection to death, in animals injected with blood taken on various days of the illness. It is necessary to note that the variation is almost entirely in the incubation period, the duration of the pyrexia being much more constant.

We have not included in the tables one guinea-pig which developed the disease 86 days after injection, although the animal was kept isolated throughout this period. This animal had been relegated to the stud as negative, and developed jaundice after becoming pregnant. Unfortunately, the identity of this animal was not established beyond all doubt, but from various corroborative evidence and the memory of the two men who cared for the animals there was every reason to believe that she was a guinea-pig which had been injected 86 days previously with human blood. The liver showed enormous numbers of spirochætæ, many more than usual. The fœtuses, about three-quarters term, were removed with the utmost precautions against contamination by maternal blood, and although no spirochætæ or lesions typical of the disease could be found in the fœtuses, an emulsion of the fœtal livers produced the typical disease when injected into a new guinea-pig. The amniotic fluid

was clear and not bile-stained, and no spirochætæ could be found in the placenta, kidney, or lung (unfortunately the liver was lost) stained by Levaditi's method.

In passage animals the incubation period is much shorter and more constant, particularly after the third or fourth passage, and when very virulent strains are used the disease would seem to commence at times within a few hours of the injection of infected material.

The pyrexia.—The temperatures are taken morning and evening. As is well known, the temperature of a normal guinea-pig varies within wide limits, and is to some extent dependent on the external temperature. On this account it is often difficult to estimate the significance of a rise of temperature, but a little experience with guinea-pigs infected with this disease enables one to recognise, with few exceptions, the inception of the pyrexia which accompanies the infection. An important point is the comparison of the series of temperatures which are being recorded at the time. The temperature rises, sometimes with sharp spikes, often with only short steps, until the maximum is reached, and then falls sharply before death. The maximum temperature shows great individual variations, and one depends rather on the nature of the curve than on the absolute figure in recognising the pyrexia of infection. We insert four charts which are average examples. Two of these are animals infected from cases not showing jaundice and one is from a fatal jaundiced case. (Charts X.-XIII.)

CHART X.

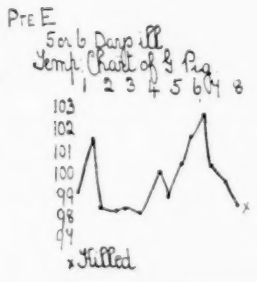


CHART XI.

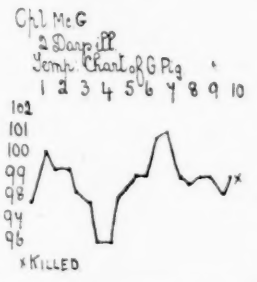


CHART XII.

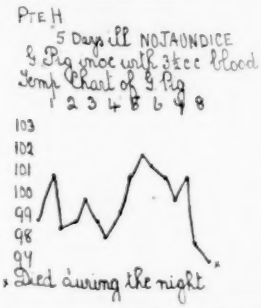


CHART XIII.

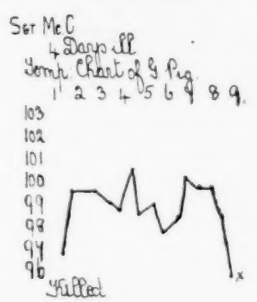


CHART X.—Animal infected from fatal case. (See Chart IX.) Spirochætæ demonstrated in Levaditi preparations of liver and kidney.
CHART XI.—Animal infected from non-jaundiced case. (See Chart VII.) Spirochætæ demonstrated in Levaditi preparations of liver and kidney.
CHART XII.—Animal infected from case with no jaundice. Spirochætæ demonstrated in sections of liver and kidney (Levaditi).
CHART XIII.—Animal infected from case with jaundice. (See Chart II.) Spirochætæ demonstrated in sections of liver and kidney (Levaditi).

In 24 guinea-pigs infected with human blood the average maximum temperature was 103° F., and in 53 animals infected with guinea-pig blood or liver (passage strains) it was 102·6° F. It may reach as high as 106° F. or more. The maximum once reached, the fall is very rapid, the downward curve on the chart being in the great majority of cases either a straight line or showing only one or two short steps. The temperature becomes subnormal and the animal dies within a few hours. This is generally 12 to 36 hours after the maximum temperature has been reached.

The duration of pyrexia from the beginning of the rise to the collapse stage is remarkably constant. In 17 of 22 animals infected with human blood this time is between three and four days, and the average for the series is 3·5 days. In passage animals the duration of pyrexia is somewhat shorter, averaging 2·7 days in a series of 38 animals. It is to be noted that with the majority of our infected guinea-pigs we have not waited for death, but have killed them to ensure having fresh material for injection, since in a few cases failure has followed injection of material from guinea-pigs which had died during the night. The animals are not killed until they are moribund, with a subnormal temperature and in a state of extreme collapse. Many animals, however, have been allowed to die, and we have never seen an animal live more than six hours after the stage at which we call them "moribund" was reached.

Jaundice.—Jaundice does not appear, as a rule, until the temperature reaches its maximum; that is to say, only a short time before the collapse stage sets in. It is first obvious on the prepuce or labia, then in the sclerotics, and rapidly increases till the skin becomes deeply yellow. In the passage animals, when death supervenes rapidly, the jaundice is never so marked as when the pyrexia period is more prolonged.

Other symptoms.—The guinea-pig becomes ill when the temperature begins to rise, but the indisposition becomes more marked as soon as jaundice appears. The fur becomes ruffled, the animal refuses to eat and becomes thin and pinched, and as the temperature falls collapse sets in, with extreme prostration. At this stage the action of the heart is so weak that it is difficult to obtain blood from the ear veins for blood-counting purposes. Anæmia towards the end, when internal hæmorrhages become more extensive, is extreme. A small number of observations would seem to indicate that there is a definite initial leucocytosis. A subsequent progressive fall in the leucocyte count was observed, but the question as to whether this was not more than accounted for by the anæmia has yet to be settled by more thorough investigation of its relation to the red blood cells and hæmoglobin.

Pathological Changes in the Guinea-pig.

The post-mortem appearance in guinea-pigs which have died of the disease or which have been killed during the final collapse is very characteristic.

The skin is deeply and diffusely jaundiced, and jaundice is seen on all internal surfaces where the natural colour permits of its recognition. Numerous fine petechiæ are seen in the skin of the flanks and groin, and in the muscle layers of the abdominal wall and subperitoneally. The loose reticular and fatty tissues of the groins and axillæ show more extensive and diffuse patches of hæmorrhage. Large hæmorrhages sometimes occur in the loose retroperitoneal fatty tissue, so that the kidneys, particularly the left, may be more or less completely covered by a thin hæmorrhagic layer. The small bowel usually, but not always, shows numerous superficial hæmorrhages, usually in the form of circular or elliptical patches, 2 to 5 mm. in greatest diameter, and situate opposite the mesenteric attachment. A single injected vessel is seen leading to the patch on each side of the bowel, and the patch itself is often outlined by a fine rim of injected, anastomosing vessels. In animals killed in the early stages of the disease, however, the bowel hæmorrhages are seen as minute pin-point spots situated at the side of the bowel at about the point where the encircling vessels commence to divide. These points evidently represent the commencement of the hæmorrhagic patch. Hæmorrhagic areas are also seen on the large bowel, and, in severe infections, on the stomach. In the latter situation they appear as groups of pin-point petechiæ. Enlarged, injected, and often hæmorrhagic lymph nodes are seen in the mesentery and in the groins.

The kidneys show very fine pin-point hæmorrhages under the capsule and through the cortex on section. The adrenal glands are often seen with such large hæmorrhages that all structure is obscure. The liver is more congested and of softer consistency than normal, but otherwise shows no gross changes. The spleen is congested, though not as a rule obviously enlarged. The lungs show the most characteristic gross change, being the seat of multiple, sharply defined hæmorrhages of varying size, which contrast sharply with the white lung tissue, giving the striking appearance which the Japanese authors aptly describe as being "like the wings of a mottled butterfly." The hæmorrhages vary from 1 mm. to 1 cm. in size, the larger ones being at the bases; when the hæmorrhages are numerous they may be seen throughout the lung tissue, but when they are few they are often nearly all subpleural. They may form a strikingly symmetrical double row along the lateral margin of the lower lobe, one row on each side of the sharp margin.

The hæmorrhages are an early occurrence in the infection, A guinea-pig killed exactly 24 hours after injection showed well developed lung hæmorrhages and beginning bowel hæmorrhages. It is to be noted, however, that the strain with which this animal was injected was at this time very

virulent, and a control animal died on the third day. Four or five other guinea-pigs killed at stages from 36 to 72 hours after injection have all showed definite hæmorrhages.

Microscopic Pathology.

The liver.—The lesions seen in the guinea-pig's liver are essentially the same as those found in the two human livers—namely, uniform degeneration of liver parenchyma and an exudation of polymorphonuclear leucocytes, more extensive about the smaller bile-ducts. The degeneration varies greatly in degree, in some livers being very extensive, with considerable cell disintegration. As in the human liver, the leucocytes are found both diffusely between the liver column and in localised collections about the bile-ducts, particularly about the smallest ducts at their origin from the bile capillaries. They are also found within the bile-ducts much more commonly than in the human liver. It is to be noted that polymorphonuclear leucocytes are more numerous than normal in the blood, as seen in the vessels of all tissues. No structures which could be interpreted as dilated bile capillaries have been found in the guinea-pig liver; the quantity of bile pigment is much less in the human livers, only occasional cells showing pigment, but these often being packed with it.

After considerable study of both human and guinea-pig livers we are of the opinion that the jaundice is to be ascribed to the inflammatory process noted about the smallest bile-ducts, which probably produces a partial obstruction. If this be so, the condition must in strict terminology be called an obstructive jaundice, the result of a cholangitis or pericholangitis.

Kidney.—The lesions here, as in the human kidney, give the picture of an acute exudative nephritis with localised hæmorrhages. The degeneration of the tubular epithelium may be very extensive, so that many tubules appear to be completely necrotic. The portions affected are, as in the human, the proximal convoluted tubules and the thicker portions of Henle's loops. Leucocytes occur in varying numbers. In severely affected kidneys they are numerous within and about affected tubules, and often immediately surrounding the glomerular capsule. Tubules are frequently seen distended with masses of leucocytes. Hæmorrhages are more discrete than in the human kidneys examined, often being limited, apparently, to individual tubules, the blood lying within the tubule, and in smaller quantity between the coils. A tubule may be seen distended throughout its entire visible length with free blood and thrombus. Tubules are also to be seen distended with homogeneous albuminous exudate. Glomeruli are not markedly affected, although occasionally one may find the tuft pressed back by a mass of thrombus, or still more rarely of leucocytes.

The lung.—Under the microscope there are seen, in addition to the hæmorrhages noted in the gross, numerous smaller ill-defined hæmorrhagic areas. Thus hæmorrhages involving only four or five alveoli may be seen. The larger hæmorrhages are often limited by the boundaries of the lobule, but may be larger or smaller. They are characteristically pyramidal in section, the base lying against the pleura, which may be raised over a considerable area by a layer of free blood. The vessels leading to the hæmorrhagic areas may sometimes be seen to be filled with leucocytes, or, again, a small mass of thrombus may be seen in the vessel, but the evidence is not sufficient definitely to indicate thrombosis as the cause of the hæmorrhage. A considerable amount of cellular proliferation may be seen more evident in the alveoli bordering on the hæmorrhagic areas. Thus alveoli may be seen packed with large cells of endothelial character. Leucocytes may be seen in small numbers among these cells, or more rarely an alveolus is found filled with leucocytes. The bronchioles show no epithelial changes, but may contain leucocytes and débris.

The bowel.—Only one bowel hæmorrhage has been examined microscopically up to the present. In this case serial sections were cut through the entire hæmorrhage. These show the hæmorrhage to be associated with a large mass of lymphoid tissue, evidently, from its size and situation, a Peyer's patch. The hæmorrhage surrounds this completely in the form of a fairly thin capsule of free blood and lies entirely within the submucosa. A small amount of free blood is also seen throughout the lymphoid tissue. Through the exuded blood run widely distended capillaries, all apparently branches of the same arteriole and venule respectively—that is to say, in all the sections through the hæmorrhage only one main arteriole and venule are seen to pierce the bowel wall, and that approximately opposite the centre of the hæmorrhage.

Mesentery.—In one guinea-pig a small hæmorrhage, 1 mm. in diameter, was observed in the mesentery close to the small bowel. This portion of the mesentery was mounted entire, and the hæmorrhage was definitely seen to lie around the trunk of a small venule, the associated arteriole being quite free.

Spleen.—The spleen shows congestion and endothelial proliferation. The sinuses may be distended with large, clear, phagocytic cells containing red blood cells, leucocytes, or greenish-yellow pigment. Free pigment is also seen. These cells show not infrequent mitoses, and some show several irregular nuclei, or one giant nucleus irregularly lobed. Smaller spherical cells are also seen with a small, thin, crescentic nucleus at one border, the remainder of the cell being filled with packed red blood cells, or more commonly with eosinophile granules. These cells resemble strongly the "eosinophiles" seen in lymph nodes from cases of Hodgkin's disease.

Lymph nodes.—The lymph nodes show congestion and some endothelial proliferation, as seen in the spleen, but, save where hæmorrhages occur, no other significant change.

Adrenal gland.—In severe cases the adrenal is usually entirely hæmorrhagic, the hæmorrhage apparently originating in the medulla, and a certain amount of diffuse leucocytic exudation usually occurs.

Spirochætæ in the Guinea-pig Tissues.

The liver of the infected guinea-pig killed at the state of collapse usually shows very large numbers of spirochætæ. They lie mostly along the borders of the liver cells, more commonly at the junction of two cells, or several organisms may surround the cell like a garland, the description which the Japanese workers give. We find them, however, frequently within the cells as well, although Inada and his collaborators say that this is rare, ascribing the fact to the absence of an immune substance in the blood of the guinea-pig. The spirochætæ, in some sections at least, are definitely more numerous at the periphery of the lobule and in the neighbourhood of the smaller bile-ducts. They may be also seen in small numbers in the connective tissue around these small bile-ducts, and not infrequently within the epithelial cells or free in the lumen of the smallest ducts.

In the kidney the distribution of the spirochætæ is characteristically in discrete areas, as noted in the human kidney, so that individual tubules or groups of two or three may show large numbers, the intervening tissue being free. The site is usually within the epithelial cells or free within the lumen of a proximal convoluted tubule close to its glomerulus. Often a mass of many spirochætæ may be seen lying among the granular débris at the centre of a degenerated tubule, and the impression gained is that multiplication has taken place in this situation. Spirochætæ may also be seen occasionally in the intertubular tissue. We have never seen a spirochæta in glomerular tuft or lumen.

We have found spirochætæ in the adrenal gland, lying within the epithelial cells of the capsule. We have also found them in the spleen (fairly numerous), lymph nodes, and in the heart muscle. We have never succeeded in demonstrating them in the lung.

In the blood of the guinea-pig they are fairly numerous, especially in the passage strains where one can find them in films in every third or fourth oil-immersion field. We have never seen them so numerous in the blood as would be expected from the description given by the Japanese authors, and we have not been able to find them with dark-ground illumination in the blood unless it was first hæmolysed with distilled water or saponin and then centrifuged.

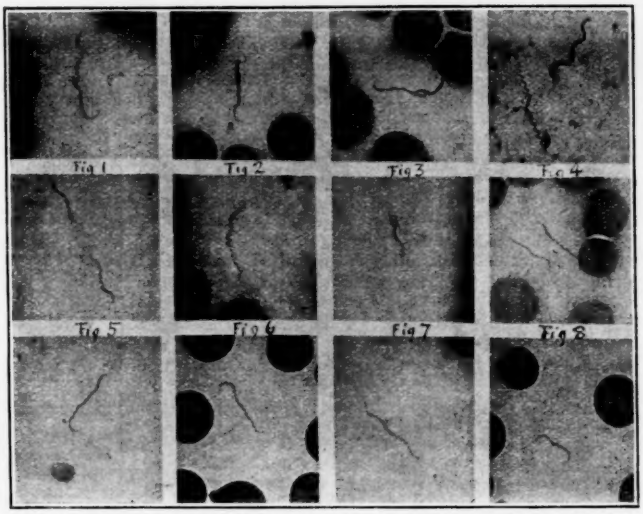
The site of multiplication of the spirochætæ has not been determined, but from the numbers found in the liver it may be that it is in that organ that they grow. If multiplication takes place in the blood stream, a possible explanation of the numbers found in the liver, and around the proximal convoluted tubules in the kidney, is the relatively slower circulation at those points.

We have found that the older Levaditi process is the more reliable method of demonstrating the organisms in the tissues; on two occasions pieces of tissue prepared by the pyridin method did not show the organisms, while with the older method they were easily found. For films from the blood or liver we have found Fontana's method the most reliable and rapid, while with Giemsa the time taken for satisfactory staining is often 36 hours, and the organisms are not so distinctive or so easily found. With dark-ground illumination we have been disappointed, although the apparatus we use—a Leitz stage and a small arc lamp—shows *S. pallida* very well. With dark-ground illumination they are much less refractile than *S. pallida* or *S. refringens*. Their movements are slow and undulating, and the most characteristic movement is from side to side at one or both ends, a central portion remaining rigid. A slow spiral movement is occasionally seen. The spirochætæ show pronounced cross striation, caused, apparently, by a uniform series of refractile "beads" and suggesting the appearance seen in striated muscle.

The spirochæta as seen in the living condition or stained is of inconstant shape and has no fixed undulations. The thickness is about that of *S. pallida* or slightly less, and the length varies considerably, being on the average about the length of a specimen of *S. pallida* showing 12 to 14 turns. In films from liver or blood the spirochæta is often nearly straight or shows only wide undulations, while the ends in the majority of organisms are seen recurved like a fish-hook. There is a definite taper to each end from the central thicker portion. In the tissues prepared by Levaditi's method the spirochætæ often show angular, irregular undulations, and the tapering at the ends is not so well seen.

We are greatly indebted to Dr. A. C. Coles (Bournemouth) for the photomicrographs which he has kindly taken for us and given us permission to use. They are taken by his special method and illustrate the appearance of the spirochæta in films very well. He has included specimens of *S. pallida* and *S. refringens* for comparison. The photographs of the organisms in the tissues have been done for us by Dr. J. T. Wigham (Trinity College, Dublin) and are also characteristic. We owe our best thanks to these helpers.

PLATE I.



Shows 11 examples of *S. ictero hæmorrhagica* in films of blood from infected guinea-pig. Multiplied 1000 diameters. Stained by Giemsa's stain. 1 example of *S. pallida* and *S. refringens* for comparison. Photomicrographs (I., II., and III.) by Dr. A. C. Coles, Bournemouth.

Technique of Passage.

In the passage of the disease from animal to animal the blood taken from the heart or an emulsion of ground-up liver is generally successful. We have found, contrary to what Inada states, that the liver emulsion is more reliable than the heart's blood. On three occasions the liver has passed the infection where the blood failed.

The liver is crushed in a mortar and to about 10 gm. of liver is added 5 c.c. of saline, and the whole is briefly centrifuged to throw down particles which could block the needle. The supernatant fluid is then injected intraperitoneally, using about 2 c.c. for each animal.

The injection should be intraperitoneal to be satisfactory, since subcutaneous inoculations give a longer incubation period, and in two or three cases we have seen abscesses or spreading infection of the subcutaneous tissues at the site of subcutaneous injection. Passage has also been performed successfully by spreading liver emulsions on the shaved skin and by feeding the animal on carrot steeped in liver emulsions. We have also passed the infection with the urine of the killed animal. One attempt to infect with the bile failed.

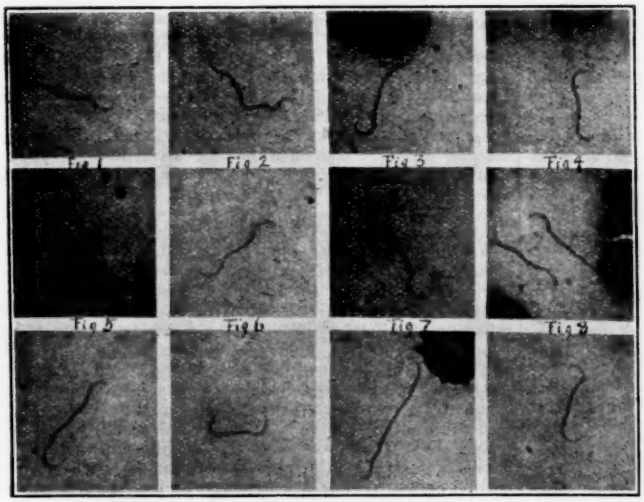
Virulence.

The virulence of the spirochætæ is very strikingly increased by passage.

The average period from injection to death in 23 animals infected from human blood was 10 days. The average time for death in 14 passages of one strain was 4·8 days, and of another strain, for 11 passages, was 5·3 days. This period for the first two or three passages may vary somewhat, but is usually 6 to 8 days; in succeeding passages it becomes progressively shorter and more constant, until a point is reached after 5 or 6 passages at which it becomes approximately fixed at 4 days. With small animals, when the strain is virulent, we have had them die on the third day, but this has always been in half-grown animals. In these young guinea-pigs the infection seemed to be overwhelming. The temperature reaction was slight and the jaundice not well developed. The duration of the pyrexia, as already mentioned, was definitely shorter in passage animals, and this becomes more marked in the later passages.

Jaundice does not have time to develop to the same extent as where the disease is of longer duration. Otherwise the post-mortem appearances show no important difference. The hæmorrhages are often more extensive but this is not constant. Another criterion by which the increase in virulence may be judged is the number of spirochætæ found in films from the blood and liver. In guinea-pigs dying from infection with human blood one may fail to find them in the blood films after 30 minutes' search of specimens stained by Fontana's method, while the liver films may show them only in 8 or 9 fields. In some animals infected from man we have only succeeded in finding the spirochætæ in sections of tissues with Levaditi impregnation. In the animals of the latter passages it is always easy to find the spirochætæ in the blood, although they are seldom numerous, but the livers of these animals show large numbers, 10 to 12 spirochætæ in every oil-immersion field of a film made from the cut surface of the liver.

PLATE II.



S. ictero-hæmorrhagica. × 1500. Various forms from blood of guinea-pig.

Experiments with Urine.

The Japanese authors showed that the spirochætæ, both in the experimental disease and the disease in man, were excreted in the urine, the excretion commencing soon after the blood began to develop a demonstrable immunity and continuing in certain cases up to the fortieth day from the onset of illness. They were also able to infect animals with the urine of patients, 3 of 9 inoculations being positive when the injection was done before the tenth day, and 5 of 15 positive when the urine was taken between the eleventh and twenty-first days. They were able to find the spirochætæ in the urine with dark ground illumination and regarded the excretion in the urine as a most dangerous source of infection. We have so far failed to find spirochætæ in the urine and to infect animals with urine, although we have

repeatedly searched for them and tried various methods of demonstrating them. It must be remembered that the patients were for the most part evacuated at the end of the pyrexial period, tenth to fifteenth day, and it is after this time that the spirochætæ become abundant. We are informed that the spirochætæ have been found with comparative ease at the base hospitals at a later period of the disease. In spite of this we think that our failure to get positive results at the earlier stage of the disease is of some significance, and think it is possibly due to the comparatively benign type of Weil's disease prevalent in this country. We have only in a few cases been able to examine the urine as late as the fifteenth day. We append a list of the experiments.

The animals were inoculated intraperitoneally with the centrifuged deposit from the amount of urine mentioned. They were inoculated with the urine of the same patient on two successive days, and were watched and had their charts kept for 14 days.

G.-p. 21	150 c.c. on	14th	and	15th	day of	illness	(Pte. G.)
,, 22	300 ,,	10th	,,	11th	,,	,,	(Pte. H.)
,, 23	150 ,,	13th	,,	14th	,,	,,	(Pte. C.)
,, 24	150 ,,	15th	,,	16th	,,	,,	(Pte. MacD.)
,, 43	170 ,,	13th	day of	illness			(Pte. L.)
,, 52	320 ,,	13th	and	14th	day of	illness	(Pte. B.)
,, 64	320 ,,	7th	,,	8th	,,	,,	(Pte. C.)
,, 67	300 ,,	7th	,,	8th	,,	,,	(Pte. T.)
,, 74	300 ,,	6th	,,	7th	,,	,,	(Gnr. W.)
,, 87	200 ,,	11th	day of	illness			(Pte. B.)

The results were consistently negative. In one of the fatal cases there was suppression of urine for 24 hours before death, and we were unable to secure a specimen to inoculate an animal. In the second fatal case which we were able to investigate there were not sufficient animals available at the time to try to infect with the urine.

Immunity.

In their first paper on infective jaundice the Japanese authors showed that the blood of convalescent patients contained substances capable of curing infected animals and of protecting them against infection; they dated the appearance of this immune substance at about the tenth day of illness, at which time it first became demonstrable. In the later paper, the proofs of which we have been allowed to see through the kindness of Dr. Flexner, director of the Rockefeller Institute, they report that they have succeeded in immunising a horse and in using the serum therapeutically with encouraging results. The following experiments were done in confirmation of the original Japanese paper:—

Experiment 1.—Guinea-pig 35. The animal developed jaundice eight days after injection, the temperature being on the downward grade after reaching 103·2° F. The animal was then injected with 2½ c.c. of serum from a patient on the fourteenth day of illness. It showed immediate improvement and began to feed, and the fur became normal; all jaundice was gone on the eleventh day. On the fourteenth day 2 c.c. of liver emulsion rich in spirochætæ was administered and did not infect the animal. This injection was repeated on two subsequent occasions with virulent strains and the animal remained immune.

Experiment 2.—Guinea-pig 40. The animal was injected at the same time with 2½ c.c. of serum from a convalescent patient, and 1 c.c. of liver emulsion with 1 c.c. of heart's blood from an animal which had died of jaundice. No symptoms developed for 14 days. A control animal died in 7 days. Guinea-pig 40, reinoculated on the fifteenth day, died four days later with jaundice and typical signs. This would indicate that passive immunity is transient, and that, although the animal was protected by the immune serum, it did not develop any active immunity, since infection had not occurred.

Experiment 3.—Guinea-pigs 41 and 47 were subjected to a repetition of Experiment 1, and the result was identical.

Experiment 4.—Guinea-pigs 45 and 46 were treated with immune and normal serum respectively when the collapse stage had been reached. Both died within three hours.

Experiment 5.—Guinea-pigs 83, 85, 86, 89, and 90 were each injected with the same quantity of virulent liver emulsion, and at the same time human serum was administered as follows:—

Guinea-pig 85.—3½ c.c. normal human serum.

Guinea-pig 83.—2½ c.c. serum from jaundice case taken on sixth day of illness.

Guinea-pig 89.—2½ c.c. of serum from same case taken on eighth day.

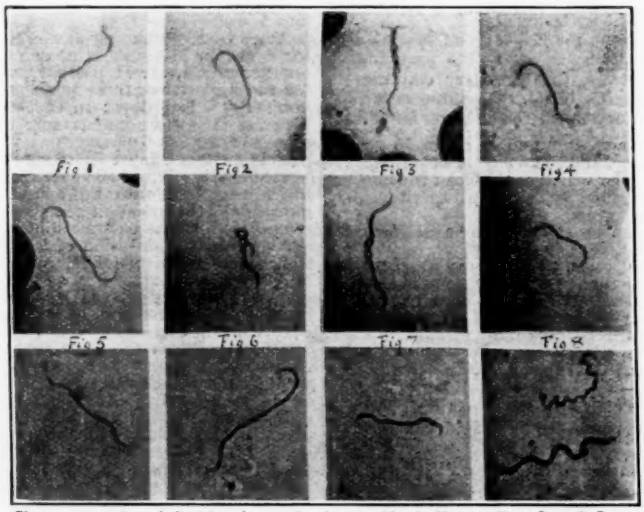
Guinea-pig 86.—2½ c.c. of serum from same case taken on tenth day.

Guinea-pig 90.—2½ c.c. of serum taken from same case on twelfth day.

Guinea-pigs 85 and 83 died on the fifth day with typical signs of the disease. Guinea-pig 89 died immediately after injection. Guinea-pigs 86 and 90 developed no symptoms.

In only one respect do the results of these experiments differ from those obtained by Inada and his assistants, who state that the serum must be given before the appearance of the jaundice in order to cure the animal. We have found that the serum of a convalescent patient will cure the animal even after the appearance of jaundice, if it be given before the collapse stage is reached.

PLATE III.



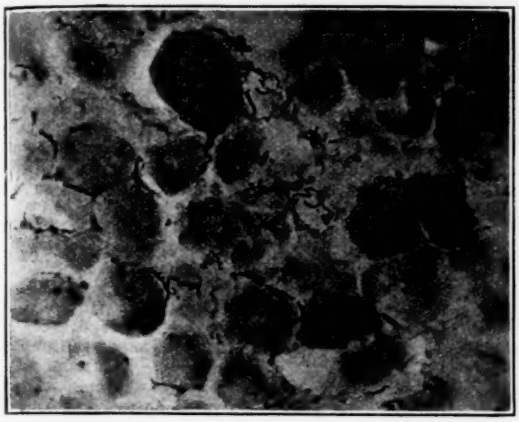
Shows examples of *S. ictero-hæmorrhagica* in blood films. Nos. 2 and 3 on this plate are *S. ictero-hæmorrhagica* from human blood, Corp. MacG. (see Charts VII. and II.). Magnification 1500 diameters. Stained by Geisma's stain.

After these experiments had been done we suggested the immunisation of a horse with a view to treatment, but the suggestion was not put into practice, partly owing to the fact that the prevalent type of the disease was relatively benign and did not seem to call for very active treatment. The Japanese workers, in their treatment with serum, succeeded in considerably lowering the death-rate, which was high (32 per cent.), but did not shorten the duration of jaundice. They also were apparently able to rid the circulating blood of spirochætæ and to hasten the appearance of the immune reaction in the blood. They found that rather large doses of the horse serum were necessary, 60 c.c. or more, and that better results were attained by early administration. This would indicate that a very high titre serum would give better results. They found that the serum which they had prepared was about as potent as that of a convalescent case. They have further attempted to produce active immunity by the injection of carbolised cultures, but the results are not as yet convincing.

Sero-diagnosis.

As soon as it became clear that there were considerable numbers of cases of spirochætosis which did not show obvious jaundice, it seemed to us desirable to find some convenient form of laboratory diagnosis other than the infection of animals. With this end in view a large number of experiments were done with a view of finding whether this could be attained by a complement-deviation test. Antigens were prepared in various ways from the livers of guinea-pigs with very great numbers of spirochætæ, but no test sufficiently reliable could be elaborated. There was nearly always a difference in the hæmolysis which held out hopes of arriving at a reliable test, but there was not sufficient constancy. For one instance immune guinea-pigs did not give a positive reaction as compared with normal

FIG. 4.



Liver of guinea-pig showing *S. ictero-hæmorrhagica*. Sections prepared by Levaditi's first method. Dr. J. T. Wigham.

FIG. 5.

Liver of guinea-pig showing *S. ictero-hæmorrhagica* (Levaditi). Dr. P. P. Laidlaw.

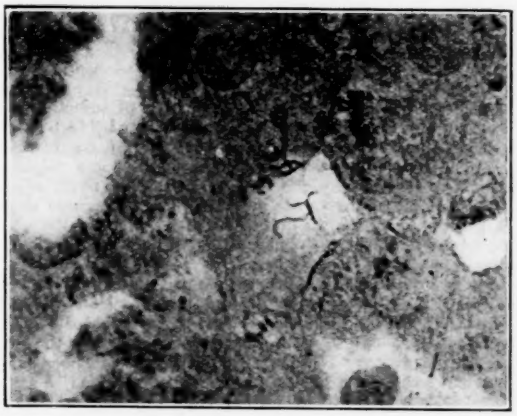
FIG. 6.

Kidney of guinea-pig showing *S. ictero-hæmorrhagica* (Levaditi). Dr. P. P. Laidlaw.

FIG. 7.

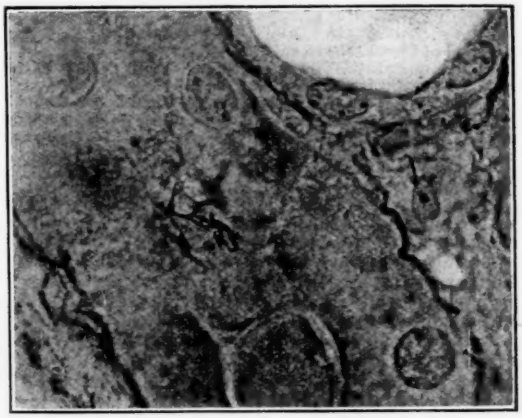
Kidney showing *S. ictero-hæmorrhagica* in human tissue. (Pte. E. See Charts IX. and X.). Dr. J. T. Wigham.

FIG. 8.



Liver of guinea-pig showing *S. ictero-hæmorrhagica*. Animal infected from case that did not develop jaundice. Dr. J. T. Wigham.

FIG. 9.



Kidney from same animal as Fig. 8. Dr. J. T. Wigham.

animals. A further point was that the bile, both in the serum and in the antigen, produced strong anti-complementary action.

Cultures.

Inada and Ito succeeded in cultivating the spirochætæ in 1915, and state that they got their original cultures by Noguchi's method.

Ito and his collaborators publish a fuller account of the cultivation of the organism in the *Journal of Experimental Medicine* for April, 1916, and have had no difficulty in cultivating the spirochætæ by taking the heart's blood of an infected animal and growing the blood in deep blood agar or blood gelatin tubes. They state that the cultures begin to grow in 8 days, the maximum being reached in 16 to 20 days. So far as we are concerned, we have been unable to obtain cultures, although we have attempted it repeatedly in different ways and at different temperatures. We tried the original Noguchi technique with guinea-pig liver and kidney as the tissue component, with blood, ascitic fluid, or guinea-pig blood as the enriching medium, and with agar or broth as the basis; in all cases the results were negative. We have tried different infecting agents, blood, liver, or kidney from animals with jaundice, and never succeeded in getting an undoubted culture. Though we have often thought that we could demonstrate the spirochætæ by staining with Fontana's method, we could not see them in such cultures with the dark-ground stage, while, conversely, on one occasion we thought that we had them in culture after examining by the dark-ground stage, but were unable to stain the organism. We attempted several times to cultivate direct from the patient, taking early cases and a relatively large amount of blood into deep agar tubes and covering with paraffin, but these efforts were also abortive.

We mention these negative results as showing that cultivation is not so simple a task as might be supposed from the literature. The possibility of an inherent difference in the organisms is to be considered.

Experiments with Lice.

When we began to consider the route of infection in the soldier our first idea was the possibility of lice being the infecting agent, as they may be said to be invariably present on soldiers serving in the field. Some colour was lent to this idea by the fact that we had never seen an officer with true infectious jaundice. The Japanese authors had considered the possibility of fleas and mosquitoes being the intermediate host and discarded both. The fact that the majority of cases came from a relatively small area, that jaundice was rare except in one part of the line, as will be more fully explained later, and that divisions which left the infected area did not have any more cases of jaundice suggested that lice were not responsible. On the other hand, the analogy of relapsing fever made it necessary to attempt some experiments on the matter. The lice seldom survived three days' separation from the human host and seemed not to thrive on guinea-pig blood.

Guinea-pig 88.—40 lice were fed on an animal which had spirochætæ in the blood-stream, demonstrated by films; on the next day the survivors were fed on a fresh animal (Guinea-pig 88), and again on the following day the survivors were fed on this same animal. Result negative.

Guinea-pigs 97 and 98.—The same as above.

Guinea-pig 122.—50 lice were allowed to feed on a patient on the fifth day of his illness, and were then fed alternately on the patient and the animal till there were no survivors at the end of 60 hours. Result negative.

Guinea-pig 124.—The same experiment with another patient on the fourth day of illness.

Guinea-pig 123.—100 lice were taken from the clothing of a patient on the sixth day of illness, crushed and emulsified in saline, and injected into the peritoneal cavity of the animal. Result negative.

Guinea-pig 129.—Same experiment as the last with 40 lice. Result negative.

Guinea-pig 125.—Lice taken from the clothing of a patient on the ninth day of illness were fed on the animal till there were no survivors. Result negative.

There is an obvious fallacy in these experiments which is hard to eliminate. The incubation period in the louse may be prolonged and the parasite not become infective for several days, the lice dying, when kept in captivity, before the infective period is reached. Further, the lice taken from a man may not have fed on him while the spirochætæ were abundant in the blood-stream. The experiments, however, so far as they go, bear out what would have been expected from the almost strict area from which the cases came. A large number of lice have also been examined by Sergeant Peacock, R.A.M.C., by staining methods with a view of finding the spirochætæ. The lice were either taken from men with jaundice or deliberately infected from animals with spirochætæ demonstrable in their blood, and all the examinations were negative.

From every point of view we think that it is improbable that lice are the intermediate hosts if there be an intermediate host in the cycle of infection. We have tried no experiments with mosquitoes, and though the incidence went up as the warm weather set in and has declined with the colder weather, when mosquitoes are scarce, it is not sufficient evidence to incriminate these insects. There were, however, undoubted cases during last winter. The restriction within narrow limits of the epidemic is also in opposition to the hypothesis of transmission by the mosquito.

Epidemiology.

There were, as we are informed, undoubted cases of Weil's disease during the winter of 1915–1916 which were seen at the base hospitals, but the diagnosis was not confirmed by animal inoculation. So far as we know, the first cases which were recognised in this area occurred at the end of April and the beginning of May, 1916. The number of cases varied from time to time. There were more cases seen during the early part of July and the end of August than at any other periods, though there were a few cases passing through during the whole summer. At one time there were 15 cases under observation, and others had been evacuated on admission as sufficiently well to travel. The incidence seemed to vary with the weather conditions. Thus during and immediately after a dry, warm spell of summer weather there were very few cases, but with the advent of rainy weather the incidence went up and many cases were admitted. On two occasions this occurred, the most striking being after the dry spell which prevailed during the end of July and the first fortnight of August. From August 1st to the 23rd there were no cases of jaundice, and from August 23rd to Sept. 1st 12 cases were admitted. Rain fell in considerable quantities from August 13th to the end of the month.

We know of only one officer who definitely developed Weil's disease, all the cases having occurred among the other ranks and practically always among the "trench troops." The men always either developed the disease in the front line or very soon after they had been relieved. Certain divisions in a corps were affected, others being free. Within the divisions certain brigades were affected, and within the brigades certain regiments had more cases than others. We found that a regiment which had a number of cases while in the line was not infected while in rest billets, but again produced cases when it returned to the trenches. There were certain areas from which cases came, and if we represent the line from which we collect as a straight line divided into six segments, numbered from left to right, Segment 1 and Segment 4 provided the great majority of cases.

1	2	3	4	5	6

By the kindness of Colonel Gerrard, A.M.S., we were allowed to see a "spot map" of Sector 1, which had been kept for about two months, the map representing the cases as they occurred among the troops in occupation of the area, and giving the place where the affected men had been on duty. This map showed that the cases in the infected area were grouped round two small sections of trench, one at each end of Sector 1.

A new division, which had, up to the time of taking over the infected area, never had a case of jaundice, developed cases of jaundice within 14 days of going into the new trenches, and the same division, after being relieved and going to a new part of the line, was again free from cases. Again a new division took over the infected area, and in the same way cases of jaundice cropped up within a short time.

The trenches in this infected area were wet, not well drained owing to the nature of the ground, and in some places, even in dry weather, never properly dried. This was so in both the segments of the line from which cases came. This is suggestive when one remembers that Inada and his collaborators state that cases of jaundice occurred in the wet shafts of a mine, and that the men working on the surface and in the dry shafts were not infected, and, further, that

when these wet shafts were pumped out on their advice the incidence markedly decreased. They also suggested that possibly the entry of the organisms might be through the skin—a guinea-pig can be infected through the skin—but they were of the opinion, after a general review, that the mode of entry was through the alimentary canal. A point of interest is, though it is complicated by the contemporary onset of colder weather, that the incidence of the disease in our area had practically ceased, and that the troops were issued with high "gum" boots a week before we saw the last case of jaundice. Since writing the last sentence two cases have been noted.

In the proofs of a forthcoming paper by the Japanese workers which was sent to us by Dr. Flexner it is stated that they have succeeded in finding the spirochætæ of jaundice in the kidneys and urine of 38 per cent. of ordinary field-rats in the infected areas in Japan. They suggest that the infection may be conveyed by the rats' urine, either directly or indirectly. We have not yet had time to confirm these findings, but hope soon to be able to do so.

Cases have occurred in the Allied troops in different parts of the front. Dr. L. Martin has published an account of some cases investigated by him in the French Army, and we also know of other cases which have occurred among the troops in Flanders which have also been proved experimentally. Whatever be the portal of entry of the spirochæta it would appear that wet and muddy trenches are a predisposing factor. If the infection had been water-borne there would have been a more widespread epidemic. If vermin or mosquitoes had been the infecting agents the epidemic could hardly have been so localised, and the experiments which we have performed, such as they are, would seem to exonerate them. We would also add that there have been up to now no ward or laboratory infections. The patients have been cared for in a general ward with no further precautions than would be carried out if they were enteric cases.

Conclusion.

The clinical and experimental examination of about 100 cases of Weil's disease which we have been in a position to investigate during the last six months justifies, we think, the conclusion that the disease, as it has been observed among British troops in Flanders, is identical with that described by Inada and his collaborators in Japan.

The virulence of the infection in the cases seen here is much less than that described in Japan, which is well shown by the comparatively low mortality. All the essential findings of the Japanese authors have been confirmed, save that our cultural attempts have so far failed.

In addition we have noted the occurrence of cases of spirochætosis which have not shown any external jaundice.

The success of our work is to a great extent due to the efficiency and zeal of our laboratory attendant, Sergeant B. Baker, R.A.M.C. (T.F.).

After-note.—Since writing the paper we have been able to confirm the statement of the Japanese workers mentioned in the paper with regard to the finding of the spirochætæ in the kidneys of field-rats. Of 9 rats taken from the right part of Segment 1 in the chart in the paper, 5 proved infective to guinea-pigs. Of 6 rats from the left end of Segment 1 one communicated the disease. The kidney of the rat was crushed and emulsified, and injected intraperitoneally into the guinea pig. The disease in the infected animal was typical, and we have found the typical *S. ictero hæmorrhagica* in the organs of the guinea-pig. Levaditi preparations of the rat kidney have shown the spirochætæ, and we have also found them in films made from an emulsion of the kidney stained by Fontana's stain.

MEDICAL SICKNESS, ANNUITY, AND LIFE ASSURANCE FRIENDLY SOCIETY.—The usual monthly meeting of the committee was held at 300, High Holborn, on Jan. 19th, Dr. F. J. Allan being in the chair. The reports submitted showed the epidemic of influenza which has been universal throughout the country to have affected the medical profession. It was decided to apply for a further £15,000 in the new 5 per cent. War Loan, and to convert the society's existing holdings, amounting to £25,500, also in the new 5 per cent. War Loan. This transaction, when complete, will give the society a total of £40,500. The important question of the depreciation of stock values was considered and a further £6000 added to the investment reserve, which now stands at £10,000.

TOXIC JAUNDICE IN MUNITION WORKERS.[1]

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CAPTAIN, R.A.M.C. (T.); PATHOLOGIST TO THE EAST LEEDS WAR HOSPITAL.

THE aspects of the subject dealt with in this contribution are: (I.) the morphological changes in the blood occurring in a series of 14 clinical cases of toxic jaundice from trinitrotoluene poisoning; and (II.) certain points in the morbid anatomy of the disease as observed in a series of seven fatal cases.

I.—*Changes in the Blood.*

The 14 cases here recorded are those of munition workers who were admitted to hospital during the months August to December, 1916. Most of them have been under observation for weeks or months, and as many of them are still coming up regularly for examination these results must be regarded as partial and preliminary. Sufficient has already been made out, however, to show that very profound changes in the composition of the blood may occur as a result of trinitrotoluene poisoning; indeed, it might be said that such changes are the rule in cases where pronounced clinical symptoms, and especially jaundice, have manifested themselves. One case only out of the 14 examined, a man who, clinically, was never seriously ill, showed no blood changes. All the others had definite deviations from the normal of some sort or another.

A. *Changes in the leucocytes*.—These were worked out on a basis of the absolute number per cubic millimetre of each variety of leucocyte, and the following fairly elastic figures were taken as the limits of the normal:—

Neutrophil polymorphs ...	3600–6750	per c.mm.
Lymphocytes	1200–2700	,,
Eosinophils	30– 360	,,

The leucocytic changes as calculated on this basis may be given as: (*a*) Neutrophil leucopenia, (*b*) neutrophil leucocytosis, (*c*) lymphocytosis, and (*d*) eosinophilia.

(*a*) *Neutrophil leucopenia*.—This, the most striking of the leucocytic changes, was present at some stage of the disease in 9 out of 14 cases (Nos. 1, 2, 4, 8, 9, 10, 12, 13, and 14). In 4 of these (Nos. 1, 2 10, and 12), 2 of them fatal, the leucopenia was extreme, under 1100 per c mm.; of the other 5 affected, the highest neutrophil count was 3175. In the 2 fatal cases (Nos. 1 and 2) the leucopenia was progressive and terminal, the final counts being 120 and 636 respectively. One case (No. 10) illustrates very well the polymorphonuclear recovery which accompanied clinical improvement in the condition of the patient. While the patient was seriously ill the neutrophils numbered only 1080 and 1092. A fortnight after her discharge from hospital they were 6280. In 3 cases (Nos. 2, 8, and 10), one of them fatal (No. 2), neutrophil leucopenia was associated with an anæmia of pernicious type (*vide inf. a*).

A progressive failure of the leucoblastic function of the bone marrow is therefore to be regarded as one of the most common manifestations of severe trinitrotoluene poisoning, but that it is not a constant feature in fatal cases is shown by Case 3, details of which are given below. It may be mentioned also that in another fatal case, which was not investigated during life, the bone marrow showed evidence of great leucoblastic, as well as erythroblastic, activity. Here the whole duration of illness was only one month, yet the liver changes were extreme, and it seems reasonable to suppose that there had not been time for the development of the full toxic action on the marrow. Whether this neutrophilic failure is due to a direct action of the poison on the leucoblastic tissue one cannot say with certainty, inasmuch as all the cases in which it occurred presented clinical evidence of an antecedent or accompanying hepatic lesion (jaundice, &c.), while both the fatal cases showed a typical advanced trinitrotoluene cirrhosis of the liver post mortem.

(*b*) *Neutrophil leucocytosis*.—This change was present in a notable degree in one (fatal) case only (No. 3). Here, at the first examination, the total leucocyte count was 14,200,

[1] A contribution to the discussion on the subject at the Royal Society of Medicine on Tuesday, Jan. 23rd.

of which 10,000, or 70·5 per cent., were polymorphonuclears, while a month later, on the day before the patient's death, the figures were 22,000 and 19,200 (87·25 per cent.) respectively. This change was unassociated with any variation in the lymphocytes or in the red cells or hæmoglobin, but at the first count there was an eosinophilia of 1000 per c.mm. Post-mortem examination showed the bone marrow in the shaft of the femur to be largely fatty, with a narrow peripheral zone of red. Microscopically there were found small foci of very active leucoblastic proliferation. The inspection,

Table giving a Summary of Blood Changes in 14 Cases of Trinitrotoluene Poisoning.

Case.	Age.	Lymphocytosis.	Polymorphonuclear.		Anæmia of pernicious type.	Eosinophilia.
			Leucocytosis.	Leucopenia.		
1	30	—	+sl.	++	—	—
2	35	+	—	++	+	—
3*	52	—	++	—	—	+[1]
4	24	+	—	+	—	—
5	28	+	—	—	—	+[2]
6	20	+	—	—	—	—
7	40	++	—	—	—	—
8	19	++	—	+	+	—
9	22	+	+sl.	+	—	—
10	49	+	—	++	+sl.	—
11*	31	—	—	—	—	—
12	34	—	—	++	—	—
13	18	+	+sl.	+	—	+[1]
14	17	—	—	+sl.	—	—
—	—	+, above 3000, ++, above 4100 per c.mm.	+, over 6800, ++, over 19,000 per c.mm.	+, under 3200, ++, under 1100 per c.mm.	+, Erythrocytes under 1,600,000, +sl., under 3,000,000, per c.mm.	+[1], over 1000, +[2], over 400 per c.mm.
—	—	Upper limit of normal, 2700 per c.mm.	Normal limits, 3600-6750 per c.mm.		In each case colour index above 1.	Upper limit of normal, 360 per c.mm.

* Male.

however, failed to reveal any inflammatory cause for the persistent leucocytosis, which stands out in striking contrast to the other fatal and clinically serious cases. In three other cases (Nos. 1, 9, and 13) an early and slight neutrophilia was present, but was speedily followed in each instance by a pronounced leucopenia.

(*c*) *Lymphocytosis.*—This was one of the most commonly observed changes; it occurred at some time or other in 9 out of 14 cases (Nos. 2, 4, 5, 6, 7, 8, 9, 10, and 13), and varied in different patients from 3150 to 5100 per c.mm. Considerable variations were often seen from time to time in the same patient, but the fluctuations were irregular and did not appear to have much, if any, significance. In the remaining 5 cases the lymphocytes ranged within normal limits, except that in two cases (Nos. 8 and 10) there was a single temporary drop to 1040 and 1160 respectively. The chief point to be observed is that even in fatal cases and in those showing profound polymorphonuclear or erythrocytic failure the lymphocytes were maintained at or above the normal level. In two cases a lymphocytosis was the only change noted.

(*d*) *Eosinophilia.*—This was observed in three cases (Nos. 3, 5, and 13), and in two of these it was well marked, once (No. 3) accompanying a marked neutrophil leucocytosis, once (No. 13) with a slight neutrophilia. It appears to be of doubtful significance, but it may be noted that in no case did an excess of eosinophils coexist with a neutrophil leucopenia. Altogether the number of eosinophils was found to be a very variable quantity in these cases.

B. *Changes in the erythrocytes and hæmoglobin.*—These have been much less conspicuous than the leucocytic changes. A serious degree of anæmia was observed in 3 cases only, all the others, including 2 of the fatal cases, had red cell counts of over 4,000,000, but a slight grade of chlorotic anæmia was present in several. In the 3 serious cases the anæmia was of the "pernicious" type, with a colour index over 1, but very varying degrees of severity were presented. In the most extreme case there was a fall in the red cells to well under 1,000,000, and as the hæmoglobin was not reduced to anything like the same extent (25–30 per cent.) a high colour index (1·5 to 1·8) presented itself. The erythrocytes in this case were greatly altered qualitatively, anisocytosis was well marked, with many megalocytes. During the worst phase numerous erythroblasts made their appearance, and polychromatophilia was present. In the other 2 cases the red cells fell to 1,500,000 and 2,900,000 respectively, with colour indices of 1·4 and 1·1. Qualitative changes in the red cells were not striking, some anisocytosis with many megalocytes, and in one case slight polychromatophilia. It is to be noted that punctate basophilia was not seen in any case, which is in striking contrast to the findings of Malden in workers in dinitrobenzene and anilin.

II.—*Some Points in the Morbid Anatomy.*

One of the chief problems here is the nature of the liver changes. The lesion appears to lie somewhere between a subacute yellow atrophy and an ordinary multilobular cirrhosis of irregular distribution. The action of the poison on the hepatic cells is probably slow and insidious, and the degenerative changes are speedily followed, if not actually accompanied, by leucocytic infiltration and fibroblastic overgrowth. The degenerative and other processes, once set agoing, are progressive, even when the patient has been removed from the influence of the poison, and in a certain proportion of cases a fatal termination ensues in from 4 to 12 weeks after the first symptoms. Certain portions of liver tissue escape complete destruction, and these show evidence of more or less regenerative hyperplasia. It may be assumed that in some cases this persistent and regenerated hepatic tissue will be sufficient to maintain the life of the individual for a considerably longer period than three months, but what the ultimate fate of such persons will be time alone can show. The after-history of surviving cases of trinitrotoluene poisoning will require to be carefully investigated, not only on account of their great intrinsic interest, but also for the light they may throw on cirrhosis of the liver in general.

I have recently had the opportunity of examining, post mortem, 12 cases of accidental death in workers at a munition factory. In one of these, a woman aged 38, distinct liver changes were discovered—namely, an early but definite round-cell infiltration of the portal tracts and numerous discrete (? regenerative) nodules of varying size scattered throughout the organ.

With regard to the series of 7 post-mortem examinations on which these remarks are based a few points of outstanding interest may briefly be referred to.

The weight of the liver varied from 20 to 32 ounces, the average being 27 ounces. The degenerative cirrhotic process, as evidenced by the dark-red contracted areas, was always most advanced in the left lobe and inferior marginal region of the right lobe. Often these two portions of the organ were composed almost entirely of red tissue. Another striking feature was the frequency with which large rounded yellow nodules projected from the under surface of the right lobe on each side of the gall-bladder, less often from the Spigelian and quadrate lobes.

The bone marrow of the femur was examined in 6 cases. In 5 of these the red marrow was in excess, extending well down the shaft of the bone, but on microscopic examination a definitely erythroblastic reaction was found in one case only. Here the yellow marrow of the shaft was completely replaced by a cellular red marrow, the appearance being comparable to that seen in pernicious anæmia. Evidence of considerable leucoblastic activity was also present. Unfortunately, there had been no opportunity to examine the blood during life. In Case 3, the patient with neutrophil leucocytosis, the shaft marrow was fatty, with a narrow red layer next the bone. Microscopically some small foci of active leucoblastic proliferation were seen.

The spleen was never appreciably enlarged, the weight varying from 4 to 7 ounces in different cases.

Ascites to the extent of five or six pints was present in 3 cases. Clinical examination of the fluid in one case showed a very scanty cellular deposit with a preponderance of leucocytes. A very few red blood corpuscles and endothelial cells were also present.

Hæmorrhages in various situations were present in 5 cases, most frequently in the peritoneum and pericardium, less frequently in the stomach, lungs, pleuræ, endocardium, and skin. In one case there was very extensive hæmorrhage into the peritoneum and subperitoneal cellular tissue, especially

of the omenta, mesocolon, mesentery, and appendices epiploicæ. In the same case there was profuse terminal oozing into the stomach. In the other 4 cases the hæmorrhages were mainly petechial.

Perhaps the most interesting single case was that of a man, aged 52, where the lesions of trinitrotoluene poisoning were associated with a well-marked hæmochromatosis affecting especially the liver, pancreas, and abdominal lymph glands. Unfortunately, the urine had not been examined during life, and at the post-mortem examination the bladder was empty. The hæmosiderin granules, which gave a bright blue colour when treated with potassium ferrocyanide and hot hydrochloric acid, but a green colour with cold hydrochloric, were most abundant in the lymph glands. It is fairly certain that we are here dealing with two independent affections, inasmuch as it has been shown that a very long time, a year or more, is required for the deposition of such large amounts of iron-containing pigment, while the illness due to trinitrotoluene was in this man's case only of 10 weeks' duration. It is possible, however, that the pre-existing hepatic lesion may have made that organ unduly susceptible to the action of the poison.

Leeds.

Reviews and Notices of Books.

Gynecology.

By WILLIAM P. GRAVES, A.B., M.D., Professor of Gynecology at Harvard Medical School. With 303 half-tone and pen drawings by the Author and 122 microscopic drawings by MARGARET CONCREE and RUTH HESTIS; 66 of the illustrations in colours. London and Philadelphia: W. B. Saunders Company. 1916. Pp. 777. Price 30*s*.

THIS is designed both as a text-book and a general reference work. It is divided into three parts; the first deals with the physiology of the pelvic organs and the relation of gynæcology to the general organism, the second is intended primarily for the undergraduate and deals with gynæcological diseases, and the third is devoted exclusively to the technique of gynæcological surgery, and is written for the assistance of the advanced student and practitioner. The section dealing with the relationship of gynæcology to the general organism forms a most interesting and instructive review of our knowledge on these points and will prove extremely useful to the student in view of the increasing importance at the present time of the internal secreting glands. It includes an account of hypo-function of the ovaries and its relation to infantilism and a useful résumé of Schickele and Keller's views on chronic metritis and cystic degeneration of the ovaries and their relation to uterine hæmorrhage. Our knowledge, scanty as it is, of the relations to gynæcological diseases of the thyroid, the parathyroid, the adrenals, and the hypophysis is also excellently summarised. As the author points out, the subject is a comparatively new one, and he is anxious to impress upon the student the importance of the correlation of all the branches of medicine and surgery. The completeness with which the author treats these subjects is exemplified by the fact that he includes in his review such conditions as the nervous system, the peritoneum and omentum, the bones and joints, the gall-bladder, and the acute infectious diseases.

Part II. contains a very good account of the common gynæcological affections. We notice that the author does not distinguish between kraurosis and leucoplakia vulvæ, and the statement that the main symptom of kraurosis is itching is not quite correct. Professor Graves correctly points out that the subject of endometritis is in a state of considerable confusion, yet he does not do much to simplify matters, as he still describes gland hypertrophy resulting from circulatory changes under the heading of endometritis. The section on cystitis and pyelitis is good. There is an interesting description of the radiation treatment of cancer and of Percy's heat treatment. The excellent results obtained by Howard Kelly in the treatment of fibroid tumours by radium are also alluded to—a mode of treatment of much promise for the future. It is surprising to find in so excellent a book a recommendation of the use of intra-uterine pessaries in the treatment of anteflexion of the uterus. In the section dealing with the amenorrhœa of youth, Professor Graves also quotes Rieck's treatment of amenorrhœa and oligomenorrhœa by the intra-uterine stem pessary only to condemn it. Would it not have been better to have omitted it altogether?

The various gynæcological operations are well and clearly described in Part III., and the value of the book is greatly enhanced by the very numerous and good illustrations, mainly drawn by the author himself. The drawings of the microscopic sections are also good, and the index is a complete one.

Raymond, or Life and Death.

By Sir OLIVER J. LODGE. London: Methuen and Co., Limited. 1916. Pp. 404. Price 10*s*. 6*d*. net.

MORE than three years ago, in his presidential address before the British Association, Sir Oliver Lodge stated his conviction that memory and affection are not limited to that association with matter by which alone they can manifest themselves here and now, and that—as a corollary of this persistence—personality itself persists beyond bodily death. He had been led to this conclusion, not by such things as intuition and revelation, but by the careful and systematic examination of occurrences still regarded as occult, and by the reduction of these to order through the methods of science. The book before us records a further examination of the evidence for the survival of personality in a particular case, and as the case is the writer's youngest son, who met his death during the attack on Hooge Hill in September, 1915, it has a special and poignant interest.

Sir Oliver Lodge deals with his subject in three parts. The first, described as the "Normal Portion," gives a short biographical sketch of Raymond Lodge as he was in life, with his letters from the front and others from brother officers about him. The second part is entitled "Supernormal Portion," and deals with the messages received from Raymond Lodge after his death—"communications," as the author describes them, "from which sentiment is not excluded, though still they appear to be guided and managed with intelligent and on the whole evidential purpose." In the third part, with the heading "Life and Death," the author defines the part which he takes in the great controversy and his view of "the real existence of some kind of vital essence or vivifying principle as a controlling and guiding entity."

With the first and third parts criticism has little place. For the intimate glimpse into a strenuous young life lamentably cut short nothing but gratitude can be felt, and this part alone makes the book worth reading. The equally intimate glimpse into the author's own philosophy—the result of a lifetime of steady patient work and thought—is a second gift of no mean value. The value of the "communications" is much more difficult to appraise. The obvious criticism must indeed arise in every mind: how trivial and indeed almost contemptible are the communications themselves. And the author has done well to devote a chapter to precisely this criticism, explaining that the demand for a proof of the identity of a departed friend is best achieved by the recalling of trifling reminiscences. Affection and lofty sentiment must be the common attributes of the spirit world, but particular little jokes and morsels of fun give away the identity of the "communicator." Let us grant this as reasonable, and let us accept the possibility of communications by this means through a sensitive control, we believe, for our part, that intercourse between spirit and spirit, when any occurs, occurs without the medium of a control. Sir Oliver Lodge appears to have reached by a system of wiring and motor-transformers what may conceivably be freely accessible in wireless telegraphy—if such a simile can be justified.

LIBRARY TABLE.

Text-book of Nervous Diseases for the Use of Students and Practitioners of Medicine. By CHARLES L. DANA, A.M., M.D., LL.D., Professor of Nervous Diseases in Cornell University Medical College. Eighth edition. Bristol: John Wright and Sons. 1916. Pp 632. Price 21*s*. net.—Dr. C. L. Dana's well-known text-book of nervous diseases has reached an eighth edition. The previous one was reviewed by us in 1910, but such are the advances in the study of diseases of the nervous system that text-books rather rapidly become

out of date. It was inevitable, for instance, that after a lapse of six years chapters on nervous syphilis and on the serology of nervous disease, on poliomyelitis and epidemic cerebro-spinal meningitis, would require to be largely rewritten, and Dr. Dana has, as a matter of fact, completely remodelled these and other important sections of his book. Among the latter may be specified the articles on the psychoneuroses; neurasthenia has been pushed rather into the background, in the sense that it has undergone a dismemberment; but the writer trusts that he has given a measure of justice to psychoanalysis, because of its place "in the interpretation and occasionally in the therapeutics of the minor psychoses." In its present attractive form Dr. Dana's text-book is assured of still wider recognition and appreciation. To those in search of a not too bulky but not too superficial treatise on neurology written mainly from the clinical viewpoint it can be confidently commended.

A Glossary of Botanic Terms, with their Derivation and Accent. By BENJAMIN D. JACKSON. Third edition. London: Duckworth and Co. 1916. Pp. 427. Price 7*s.* 6*d.* net.—This glossary was first issued some 16 years ago by the author, who is the general secretary of the Linnean Society of London, with the object of supplying the student with concise definitions of the botanical terms he is likely to meet, and of helping the expert to recall an obscure term or word employed in a special sense, and the dual purpose has been well fulfilled. The total number of words in the glossary is now 21,000, and their definitions are precise and clear, while the selection of type facilitates easy reference. Obsolete terms are included in order that original papers or books of any period may be understood. The author acknowledges the assistance of a number of experts, including Sir Francis Darwin, in the preparation of the work for the press.

Surgical Operations with Local Anæsthesia. By ARTHUR E. HERTZLER, A.M., M.D., Surgeon to the Halstead Hospital. Second edition. New York: Surgery Publishing Company. 1916. Pp. 312. Price $3.—We spoke favourably of this little book when it first appeared, and the additions which have been made to it will be found useful. The scope of the work has now been enlarged to include many surgical procedures which may certainly be described as major operations, but any surgeon who wishes to employ local anæsthesia should understand that practice is required to obtain the best results, and he will be wise at first to confine himself to the small operations. No doubt with practice some extensive operations can be performed satisfactorily under local anæsthesia, but it is doubtful if such an elaborate operation as the complete removal of the breast and of the contents of the axilla can be thoroughly carried out without a general anæsthetic. The book will serve its purpose as a trustworthy guide to the use of local anæsthetics.

Fleas as a Menace to Man and Domestic Animals: their Life-history, Habits, and Control. By JAMES WATERSTON, B.D., B.Sc. Economic Pamphlet, No. 3. Illustrated. London: Trustees of the British Museum. 1916. Pp. 21. Price 1*d.*—The flea follows the house-fly and the louse in the pamphlets of the economic series issued by the Natural History Museum. Mr. Waterston, who is entomological assistant at the Imperial Bureau of Entomology, gives a short introduction stating the case against the flea as a carrier of disease, and then devotes ten pages to its structure and habits. The directions for the control of the pest are essentially practical and include the results of recent research.

THE CONTROL OF VENEREAL DISEASES.

Public Meeting in Belfast.

A VERY largely attended meeting, convened by Sir Crawford McCullagh, Lord Mayor of the city of Belfast, was held in the City Hall on Thursday, Jan. 18th. The Lord Mayor, who occupied the chair, said that the information placed before him by a large and influential deputation was a revelation and surprise in regard to the inroads venereal diseases had made into the life of the entire community. He advocated the formation of a strong council in Belfast to do all that could be accomplished to stop the terrible evil. Professor J. A. Lindsay, in proposing a motion to form a branch of the National Council for Combating Venereal Diseases, gave a full account of the work of the Royal Commission and of its recommendations, and urged a forward movement. The Bishop of Down, Connor, and Dromore (Rev. Dr. D'Arcy), in seconding the motion, said he did so with a profound sense of duty, and pointed out that the present movement had nothing to do with the State regulation of vice, a line of action which he denounced as a mistake morally and an utter failure from the point of view of health, national and personal. The motion was supported by Sir John Byers, who dealt specially with the effects of venereal diseases on women and children, the economic loss to the nation caused thereby, and the relationship of the diseases to maternal and child welfare. He expressed himself as strongly in favour of notification. The Moderator of the General Assembly of the Presbyterian Church (Rev. Dr. West) moved, and Captain W. J. Wilson, R.A.M.C., specialist sanitary officer in the North of Ireland Command, and lecturer in hygiene and preventive medicine in Queen's University of Belfast, seconded a motion appointing a general and executive committee.

Council and Other Schemes.

The City of London Corporation's scheme for the establishment of a treatment centre in Golden-lane has now received the approval of the Local Government Board, assuming that the Corporation are satisfied that the establishment of the centre away from a hospital will not deter patients from attending through fear of being recognised.—The county councils of East Suffolk and Norfolk and the county borough of Great Yarmouth are arranging with the city of Norwich for a combined treatment centre at the Norfolk and Norwich Hospital with six beds for patients of each sex and a laboratory with competent pathologist. The medical officer will visit outlying districts in a consultant capacity as occasion requires. The cost to the hospital for the first completed year of the scheme is estimated at £1600, of which the city of Norwich is to bear two-fifths.—Dr. F. Shufflebotham reported last week to the Staffordshire county council that their public health committee was shortly to draw up a scheme including treatment centres at the North Staffordshire Infirmary (Stafford) and the Wolverhampton General Hospital.

Enlightenment Campaign.

A little book entitled "Prostitution: The Moral Bearings of the Problem," just published by P. S. King and Son (239 pages, price 1*s.* net) for the Catholic Social Guild, contains an excellent chapter on Venereal Diseases by a former resident medical officer of the London Lock Hospital who signs himself "J. F." The whole subject-matter, while treated from the Roman Catholic standpoint, is, from a medical point of view, stated fairly and frankly. The Archbishop of Liverpool supplies a foreword containing wise thoughts on the value of modesty and the barrier set up against evil deeds by the exercise of control. The book cannot fail to have a useful influence in the sphere for which it is intended.

LETTERKENNY MEDICAL OFFICERSHIP.—At the Letterkenny board of guardians, on Jan. 19th, the party which had been in a minority in the previous week was now in the majority, and granted the money for medicines and appliances refused the previous week.

EDINBURGH ROYAL INFIRMARY.—At their recent meeting the general court of contributors to the Royal Infirmary remitted to a committee to consider the report of the managers and the accounts, and the report of the committee has now been prepared. It states that during the past year the managers had taken part with other institutions in the founding of a College of Nursing, the principal objects of which are to promote the better education and training of nurses, to form a register of fully qualified nurses, and to obtain a measure of State recognition for the profession. It is hoped to raise the status of trained nurses by the institution of this College and at the same time to secure adequate recognition of the important work they are performing for the welfare of the nation. A Scottish board has been created to supervise and control the work so far as Scotland is concerned, and the Royal Infirmary has direct representation on the board. The report of the committee of contributors referred to the proposal to give the miners a more distinct voice in the conduct of the institution. The miners had already increased their subscriptions and the managers found themselves in favour of the proposal to give them representation on the managing board.

THE LANCET.

LONDON: SATURDAY, JANUARY 27, 1917.

The Problems of Tetanus.

THE present war has set us many problems in the treatment of disease, and though much progress has been made in all sorts of directions, every step forward invariably reveals new paths inviting exploration. One of the most important diseases occurring in the armies on either side is traumatic tetanus. Here, indeed, much has been accomplished. It is incontestably proved that a prophylactic dose of tetanus antitoxin has a really wonderful effect in reducing the incidence of the disease; but from the very fact that through the use of the antitoxin an attack of tetanus is prevented arises a great difficulty in deciding in what proportion of cases the disease has been prevented by the antitoxin and in what proportion of cases the disease would not have occurred, even though no antitoxin had been given. Still the great fall in the number of cases in which tetanus occurs, even though other conditions have remained unchanged, tells us, without the possibility of error, that tetanus antitoxin has a very real action in the prevention of the disease. Almost as striking in its testimony to the value of tetanus antitoxin is the appearance of local tetanus and other modifications due to the effect of a prophylactic dose, insufficient wholly to prevent the disease but sufficient to modify it in one way or another. On this interesting aspect of the subject we print to-day a paper by Captain H. BURROWS, and we trust that similar observations are being made by the medical officers to whom the opportunity is given.

The main problems which have to be solved in regard to tetanus have been worked upon recently by Colonel Sir WILLIAM LEISHMAN and Major A. B. SMALLMAN, and the results that they have obtained are recorded in a paper appearing in the present number of THE LANCET. One question still open concerns even the prophylactic dose itself. It may be taken as conclusively proved that the prophylactic dose of tetanus antitoxin has a real and, indeed, great effect in preventing the occurrence of the disease, and it is equally clear that the earlier the prophylactic dose is administered the greater its preventive effect. But there was little exact knowledge as to the effects of delay, so an attempt was made by the authors to see if any precise information could be obtained hereupon, and details were sought as to the precise number of hours which had elapsed in a certain number of cases between the infliction of the wound and the injection of the tetanus antitoxin as a prophylactic. We are dealing only with cases in which the disease occurred in spite of the prophylactic injection, and the statistics obtained by the authors show that the death-rate from the disease was very definitely less when the dose was given within 24 hours of the infliction of the wound, as compared with the death-rate in those cases in which the injection was given later. Also the statistics indicate clearly that the earlier the dose is given the longer the incubation of the disease. As to the therapeutic use of the antitoxin the difficulties of forming an exact opinion are admittedly great, but a careful examination of the facts seems to show that there is definite evidence that the mortality after doses of 20,000 units is less than when a smaller dose has been given. The route by which the antitoxin should be administered does not admit of exact dictation, mainly because the number of cases is but small, yet it may be said that the figures supplied by Sir WILLIAM LEISHMAN and Major SMALLMAN go to prove that the intramuscular and subcutaneous routes offer the best chance of a favourable result.

Another problem with which the authors have dealt is the association between the occurrence and fatality of traumatic tetanus and the region of the body which has been wounded. Roughly speaking, the figures in the paper would suggest that tetanus after a wound of the body is little more likely to prove fatal than when the wound is situated on a limb. There also appears to be proof that any operation after tetanus has declared itself has a tendency to increase the mortality; but, be this as it may, it seems to be clear that it is wise to give a dose of antitoxin before operating, should an operation be needed. The number of cases investigated in the paper is only 160, but the purpose of the authors is served by their consideration, while the smallness of the number must be regarded as the result of the advance of our knowledge in the prevention of the disease, though it renders some arguments less forcible than they would have been had they been based on more material. In our opinion, the most important conclusions to be drawn from the work that Sir WILLIAM LEISHMAN and Major SMALLMAN have done, are these: That in the treatment of tetanus, when once it has declared itself, the intramuscular and subcutaneous routes should be selected in preference to any other; that the intrathecal route is by no means free from danger, and of doubtful efficacy; and that the intravenous route is no more efficacious, and is certainly more dangerous, than either the intramuscular or the subcutaneous methods. They are also of opinion that the dose of antitoxin should be large; if the intramuscular and subcutaneous routes be chosen the dose should be not less than 10,000 units per day for the first few days. It appears advisable that the administration of the antitoxin should not be abandoned too early, for recurrences may occur. It is obvious that it has been sometimes difficult for the authors to draw clear conclusions from the material obtainable. The problems are extremely complex; so many factors enter into every one of them that the results run no small risk of being vitiated by disturbing elements. But we have

no doubt that a valuable service to the study of tetanus has been rendered by Sir WILLIAM LEISHMAN and Major SMALLMAN in the investigation which we publish to-day.

The Practice of Massage.

THE function of an unused muscle is soon diminished or lost, and when the normal stimulus to contraction fails in part or wholly to reach it through its motor nerve the application of various forms of mechanical and electrical stimulation may have a useful place. The familiar physiological fact which lies at the root of all such treatment is that of the three essential parts of the motor apparatus it is the nerve cell which most readily becomes fatigued, next the muscle fibre, and only at long last the conducting nerve fibre. Where the activity of the nerve cells has been reduced by disease, disuse, or shock, much can be done by massage and appropriate electrical methods to keep the other elements of the motor apparatus in good condition until normal nervous energy is again forthcoming. The normal route is the best one; no other muscle stimulus can entirely take its place, and massage must always be looked upon as a second best. The war, indeed, with its myriads of stiffened and disused muscles has not only brought massage very much to the fore, but has given an indication of the limitations of massage and of the superiority in many cases of active and semi-active movements of the crippled limbs. All has not been done when the patient has been handed over for so long every day to a professional rubber. The indications for massage must be a matter of exact study, and skilled massage may be largely wasted when the surgeon has not been able to prescribe it correctly. There is room—urgent need, indeed—for the accurate scientific study of the indications for massage in order that the supply shall be allotted to the cases which most require it and will gain most benefit therefrom.

The supply of trained masseurs—a term which may conveniently include both genders—has been vastly increased during the war, and the demand is still unsatisfied, although, as we have hinted above, no great certainty exists that they are all being employed on essentially useful work, and that the supply is really insufficient to meet the exact indications for their services. The examination of the trained has in the past been in the hands of the Society of Trained Masseuses, founded in 1894 and incorporated six years later, with its headquarters at 157, Great Portland-street, London, W. The present position and attitude of this society, which has recently granted certificates to men as well as to women, may be seen from a letter circulated last autumn to all hospitals and schools where students are prepared for the society's examinations, the substance of which is as follows:—

> The Incorporated Society has endeavoured to fulfil all the requirements of the medical profession, and from its foundation in 1894 has had the support of medical men and women and their active assistance in examination. The recently appointed Advisory Board of the Society is representative of professional interests. The examination in medical electricity inaugurated by the society since the outbreak of war is entirely conducted by members of the medical profession, who also take part in the other examinations, including those for massage, Swedish remedial exercises, and teachers' certificate. The written part of all examinations is held at local centres, and for years past a practical examination has been held in Dublin and more recently, in response to a demand, in Liverpool and Manchester. Certificate-holders now number 3990 (men and women).

Whilst the pioneer work of the schools of massage included in the London Society has been fully recognised, the feeling has grown that on the one hand students as well as teachers of massage were at some disadvantage in the provinces as compared with the trainees in the metropolis, and on the other hand that the public and the medical profession, as well as the practice of massage itself, would gain by the establishment of a widely representative society directly under medical control, with a board of management elected annually to represent the medical profession and the various charitable institutions. The proposal materialised during the second year of the war in the formation of an Institute of Massage and Remedial Gymnastics. A meeting was held under the presidency of Sir WILLIAM COBBETT, chairman of the board of management of the Manchester Royal Infirmary, a scheme was drawn up embodying the views set forth above, and an organising committee was appointed, with the result that the Institute was formed and its articles of association licensed under the Board of Trade. The first general meeting was held at the Manchester University on Nov. 10th last, when Sir WILLIAM MILLIGAN outlined the scheme, which includes a provision that one-half of the ordinary members of the council (of whom there may be 20) shall be nominated by not more than ten charitable medical institutions of a public character. Honorary Fellows will be elected by the council from members of the medical profession, and a board of examiners will be appointed, to consist of members of the medical profession and persons possessing the necessary technical knowledge. The Institute of Massage is thus a purely examining and certifying body. No fees can be accepted by acting members of the council, and its constitution forbids those concerned in massage for a living from exercising active control in its affairs. We understand that amongst the Fellows of the Institute are the names of many prominent medical men in London, Manchester, Edinburgh, Bristol, and other large centres. The Institute of Massage and Remedial Gymnastics is therefore founded upon lines with which the medical profession can cordially agree, and the energy of its founders should carry it far. It is less evident that it can afford to dispense with the accumulated experience and the training facilities of the Incorporated Society of Trained Masseuses. It would probably be to the advantage of the practice of massage if the useful work which is being done by each separately could be done in common. We trust that conference between the two bodies will result in a working agreement.

Annotations.

"Ne quid nimis."

TOXIC JAUNDICE.

AN important discussion on toxic jaundice took place on Tuesday at the Royal Society of Medicine in the combined Sections of Medicine, Pathology and Epidemiology. Surgeon-General Rolleston occupied the chair and the discussion was opened by Dr. T. M. Legge, medical inspector of factories, who communicated an analysis of the reports of 105 certifying surgeons on jaundice due to absorption into the body of tri-nitro-toluene. The discussion which followed was an exhaustive one bearing on pathology, treatment, and prophylaxis. We are unable to do more this week than publish Dr. Matthew J. Stewart's careful study of the changes in the blood and liver cells; the former during life, the latter from 12 cases of accidental death in munition workers. The blood changes point to a progressive failure of the leucoblastic function of the bone marrow as a frequent, but not quite constant, manifestation of tri-nitro-toluene poisoning. The degenerative changes in the liver, once set going, were found to be progressive, even after removal of the patient from contact with the poison. Dr. Stewart's work illuminates one side of a new and very important question to which we shall have occasion to return.

THE EXPLOSION IN EAST LONDON.

THE enormous potentialities of the modern explosive were illustrated painfully in the recent disaster in East London, but we may well express wonder and admiration that such serious occurrences have been so comparatively rare since the gigantic work of making munitions all over the country was begun. The substantial immunity from disaster hitherto enjoyed has been due, of course, to the extreme precautions that have been insisted upon by the munition authorities and their loyal observance by the workers. It is valueless to speculate as to what happened in the present instance without stating the grounds for the different theories, and this would be a wrong course. We know that an ordinary fire had started in the factory which proved to be too rapid in its march upon the dynamic powder, although brave and splendid efforts were made to quench this fire, during which the operatives were warned to leave the building. This, no doubt, saved a number of lives, for although the loss of life outside the factory was considerable—and the list will yet be added to from a crowd of seriously hurt—the totals of killed and injured are far lower than the circumstances could have warranted. The chief chemist, Mr. Andrea John Angel, M.A., B.Sc., who perished in his endeavour to cut off the fire from the explosive material, sacrificed his life to save others, and his last deed was truly a noble one. He knew more than anybody what the fearful possibilities were, and he worked in the last moments of his life in the hope of fending them off. The explosion, though limited in its dire results by much prompt and brave action, has caused widespread havoc and misery, and the whole nation is expressing its deep and practical sympathy with the bereaved and the suffering. A tribute is due to the promptitude with which medical aid was forthcoming; no effort was spared in the ghastly work of rescue, in removing the injured to hospital for treatment, and in placing those so suddenly and cruelly deprived of their homes under shelter where food and what other comforts could be offered them were provided.

FLAVINE.

THE search for an efficient germicide within the body has gone on for half a century with undiminished enthusiasm, although the number has latterly increased of cautious people who contend that the search must be a hopeless one, because any agent that destroyed the living bacterial protoplasm would also be potent to harm the living tissue cells. The history of the treatment of phthisis has been one long attempt to find some substance more harmful to the tubercle bacillus than to the lung tissue; and the complete failure to find such a substance in the prolonged opportunities of a chronic disease has made success seem less likely in the case of short-term infections. Ehrlich's discovery of organic arsenical compounds such as "606" and "914," which fulfilled the conditions as regards spirochætes, raised drooping hopes, and Sir Almroth Wright's application of Morgenroth's optochin to the chemo-therapy of pneumonia was an apparently successful piece of germicidal work on bacteria in the living body. Optochin proved not merely germicidal in extreme dilutions quite innocuous to the tissue cells, but was equally effective in the presence of the albuminous fluids of the blood. Since then claims have steadily grown for the germicidal properties of various anilin derivatives, methylene-blue, scarlet red, and brilliant green. Emery called attention in THE LANCET of April 15th, 1916, p. 817, to the high germicidal value of malachite green, finding it, in a piece of work carried out for the Medical Research Committee on a standard method of testing antiseptics for wounds, the most powerful antiseptic he investigated. Working with the *Streptococcus fæcalis*, a crescendo series of values was given by biniodide, phenol, perchloride, lysol, malachite green. A further improvement on the last named has now been made by Captain C. H. Browning, R.A.M.C., and his collaborators in the rediscovery of flavine, an acridine derivative of complicated formula originally prepared by Benda at the request of Ehrlich, and found to have a marked therapeutic effect in trypanosome infections. The work was carried out with the aid of grants from the Royal Society's Scientific Grants Committee and the Medical Research Committee in the Bland-Sutton Institute of Pathology at the Middlesex Hospital, and published in the *British Medical Journal* of last week, when the chain of evidence for its claim was established by experimental and clinical data. The potency of flavine is not merely unimpaired by the blood proteins: it is enhanced by them, and its lethal concentration for *Staphylococcus aureus* in serum is one-tenth that required in peptone water. The factor on which the authors lay most stress is what they call the therapeutic coefficient, being the quotient of the concentration of the antiseptic which reduces phagocytosis to one-half and the concentration just sufficient to kill staphylococcus in serum. This coefficient for flavine reaches the astonishing value of 400, as compared with 6 for malachite green and ¼ for

eusol. Flavine is practically a selective bactericide. Fourteen months' testing in the casualty department of the Middlesex Hospital has substantiated the results obtained *in vitro*, and a paper by Mr. D. Ligat, acting assistant surgeon to the hospital, relates his favourable experience with the treatment of some 75 war wounds with brilliant green and flavine, of which the latter gave the better results. The preparation of flavine has been worked out under the supervision of Dr. Barger in the laboratory of the Department of Biochemistry (Medical Research Committee). A supply of it will later be available on application to Captain C. H. Browning at the Bland-Sutton Institute, and the result of independent investigations will be awaited with interest.

DIABETES INSIPIDUS AND LESIONS OF THE POSTERIOR LOBE OF THE PITUITARY BODY.

VARIOUS changes have been described from time to time as having been noted in the pituitary body and the neighbouring parts of the base of the brain in cases of diabetes insipidus. It is not yet, however, quite certain what are the structures involvement of which is essential for the production of that condition. Camus and Roussy have proved experimentally that polyuria may result, although the pituitary gland proper is not implicated. It would appear that the infundibulum is of some importance in this connexion, as in one observation removal of the pituitary gland with preservation of the infundibulum was not followed by polyuria. Ependymitis and other lesions of the floor of the fourth ventricle, including Claude Bernard's famous experimental puncture, have resulted in the appearance of either simple polyuria or diabetes insipidus. Further, a number of cases have been reported of diabetes insipidus occurring in association with basal lesions of a meningitic nature, either syphilitic or tuberculous or otherwise. In the December number of the *American Journal of the Medical Sciences* Dr. F. Parkes Weber and Dr. Hans Schmidt, of the German Hospital in London, have recorded a case of this description, where a tuberculous patient suddenly developed diabetes insipidus about two years before his death, which was due to pulmonary and laryngeal tuberculosis. The urine was of about the same specific gravity as ordinary tap-water, pale, clear, and free from sugar or albumin, and averaged about 10 litres in the 24 hours. The Wassermann test in the blood serum was negative. There were no fundus changes, no hemianopia, and no radiographic evidence of alteration of the sella turcica. Macroscopically the hypophysis did not appear enlarged, but it was obviously abnormal in its posterior lobe, a change which was readily confirmed microscopically. In proportion to the anterior lobe the posterior was much enlarged, the latter completely enclosing the former and being of a yellowish-brown colour. In the posterior lobe were found large clusters of what looked like compound granular cells; they were large cells with small nuclei staining deeply with hæmatoxylin. Their cytoplasm had a granular appearance, containing in reality innumerable minute droplets of a lipoid substance; hence, no doubt, the peculiar colour of the lobe, resembling the colour of the suprarenal cortex. The authors have not been able to find any record of a similar change in other reported cases, nor do they theorise on the possible connexion between the clinical and the pathological conditions. The case, nevertheless, is of some documentary value, especially as the nervous system, apart from the pituitary gland, was found on examination to be normal, while the other ductless glands were also normal, both macroscopically and microscopically.

CHILD WELFARE WORK.

AT the Royal Institute of Public Health last week Dr. Janet Lane-Claypon read a paper on the principles of organisation and administration in relation to child welfare work, which laid full stress on matters the importance of which the public is beginning to appreciate. The period between infancy and the commencement of school life constituted, she said, an important gap in hygienic control. Children of from 3 to 5 years developed ailments which were generally first discovered and dealt with when they went to school. By this time the simple measures sufficient to relieve might no longer be of avail. Dr. Lane-Claypon looks forward to the State aid and organisation of many branches of social work now carried on by voluntary agencies. Lecturing at the house of the Royal Society of Medicine, 1, Wimpole-street, on Monday last, by arrangement with the National Association for the Prevention of Infant Mortality, Dr. E. Pritchard welcomed the legislation in regard to the proper care of the new-born child foreshadowed by Lord Rhondda as President of the Local Government Board. A medium of useful publicity in the whole field of medical and social work for mothers and babies is afforded by a new monthly journal entitled *Maternity and Child Welfare* (John Bale, Sons, and Danielsson. Price 6*s*. per annum, post free), of which the first number has just reached us. This number contains two valuable articles by the medical officers of health of Birmingham and St. Pancras respectively, Dr. J. Robertson on Welfare Work and Dr. T. S. Higgins on the Prevention of Measles Mortality. An editorial note briefly sketches the history of welfare work, commencing with the "Consultations de Nourrissons" at the Nancy Maternity Hospital and Professor Budin's work at Paris hospitals; in this country, with the infant milk depôt at St. Helens established by Dr. J. J. Buchan, medical officer of health, in 1899, and the foundation of the first school for mothers in the borough of St. Pancras eight years later. The appearance of this new journal is fully justified, even at the present time, and we forecast a sphere of great practical usefulness for it.

EPIDURAL INTRASPINAL ABSCESS OF METASTATIC ORIGIN.

IN the *Boston Medical and Surgical Journal* of Dec. 14th last Dr. W. J. Mixter has reported a case of paraplegia due to a very rare cause—epidural abscess—which is overlooked in the text-books. Its recognition is important, as early operation offers a favourable prognosis. A youth, aged 17 years, was seen in consultation. Sixteen days previously he began to suffer from pain, increased on respiration, in the left shoulder and about the left side of the chest at the level of the fifth rib. He also complained of sore-throat. He remained at home from school for a few days and improved enough to return, but was still uncomfortable and evidently not in good health. Five days before he was seen acute retention of urine occurred. He was catheterised and examination of the urine

was negative. The next day he developed stiffness and weakness of the legs, headache, and stiff neck. The retention persisted and was rapidly followed by spastic paraplegia with temperature of 101° F., and he was taken to the hospital. Lumbar puncture yielded clear fluid, not under excessive pressure, the temperature rose steadily and paralysis became complete in the legs. On examination the temperature was 105°, pulse 118, respiration 24, blood pressure 120, and the leucocytes numbered 30,000. There was marked furunculosis of face. The throat was somewhat reddened. He was slightly confused mentally. The pupils were normal. There was no choked disc. The head was held turned somewhat to the left and the neck was stiff. There was definite ataxia of hands, but no motor or sensory paralysis of arms or hands. The arm reflexes were not increased. A definite zone of hyperæsthesia was present from 7–9 D, and there was complete anæsthesia below that level. The legs were paralysed and there was priapism. Skin reflexes: abdominal not obtained, cremasteric equal and normal on two sides, normal plantar on left, Babinski on right. Tendon reflexes: knee and Achilles jerks not obtained. Kernig's sign absent. Lumbar puncture yielded clear fluid with very faint yellow tint, not under pressure, which showed a definite coagulum on standing. Laminectomy was performed from the third to the sixth dorsal vertebræ inclusive. Beneath the epidural fat and outside the dura was found a cylindrical abscess cavity running from the third cervical to the first lumbar vertebra and containing creamy, greenish-yellow pus under considerable tension. No evident focus of infection could be made out. The abscess cavity was drained with rubber and the wound closed rapidly. The patient died a few hours later. No necropsy was allowed. The pus showed a pure culture of staphylococcus aureus. Evidently there was transverse myelitis due to an acute process; an abscess was thought the most probable. Dr. Mixter thought the abscess to be metastatic from the furunculosis or from tonsillar infection. The possibility of extension from osteomyelitis of a vertebra must be considered, but the condition found on operation seemed to negative this. While extradural abscess formation of this type is rare, its importance is considerable in that operation undertaken early should relieve the paralysis and bring about a cure. The prognosis should be considerably better than when the abscess is secondary to infection of the spine.

THE LANCET, VOL. II., 1916: THE INDEX.

OWING to the continued shortage in the paper-supply the Index and Title-page to the volume of THE LANCET which was completed with the issue of Dec. 30th, 1916, have been printed separately, and copies have been supplied gratis to those subscribers who have, up to Jan. 25th, intimated to us their wish to receive them. Other subscribers will be similarly supplied, so long as the stock remains unexhausted, on application to the Manager, THE LANCET Office, 423, Strand, London, W.C. Such applications should be sent in at once.

OUR contemporary the *Scotsman* celebrates the 100th anniversary of its birthday as we go to press. We congratulate the journal on its well-earned success, especially as it provides its readers with a steady supply of well-considered medical information of exactly the kind that benefits the public.

PARIS.

(FROM OUR OWN CORRESPONDENT.)

Recrudescence of Rabies.

FOR some time past there has been throughout the whole of France an increase in the number of cases of rabies. Rabies has for a long time been epizoötic in this country, but it is certain that the situation will be kept well in hand if the regulations are seriously applied. In the Department of Seine cases of hydrophobia in man have been entirely suppressed for some years, thanks to the systematic capture of stray dogs. At the outset of the war the abandonment of a large number of dogs in consequence of the general mobilisation and of the exodus from Paris gave rise to some anxiety. In September, 1914, the Prefect of Police instructed local mayors and commissioners of police to take all necessary precautions. The number of captures of ownerless dogs rose to 4860 and observation showed that they had been for the most part abandoned by their owners, who removed the collars in order to avoid responsibility. The precautionary measures bore fruit, for in Paris from July, 1915, to March, 1916, there was no case of rabies and treatment at the Pasteur Institute was numerically much reduced, but from May, 1916, on the cases began to increase. Happily for Paris the city and even the department have not been affected by this recrudescence, but it must not be forgotten that more than a careful search for stray dogs is required. The sympathetic public must be put on guard against the danger of giving shelter to stray dogs found wandering in public places, for it cannot be known whether they have not been contaminated by the accidental introduction into Paris of dogs bitten and infected outside.

Professional Re-education of Soldiers.

A conference on the professional re-education of war cripples, arranged by the Belgian Government, with the coöperation of the French Government authorities, will be opened on March 6th at the Ministery of Labour and Social Welfare in Paris. The conference will have before it very important questions to examine, such as the re-establishment of the functions of limbs injured by gunshot wounds, the replacement of the war cripple in his proper surroundings, his re-adaptation to a new profession, the attempt to raise him to a superior level and to place him under the most advantageous conditions for himself and society at large; in brief, to assure to the war cripple a permanent living. The whole constitutes a task of which the magnitude and necessity are obvious, as well as the great difficulties attached to its execution. To surmount these difficulties the common experience acquired during the first two years of war in the allied countries is to be placed under contribution.

Poisoning by Motor-gas in Ambulances.

M. Tanon, at a medical reunion of the 5th Army, drew attention to the inconveniences attendant on the heating of ambulances by the exhaust-pipe of the motor. When the latter functions badly and the joints of the tube are not close a discharge of gas may occur in the interior of the carriage, and result in consequences which in certain cases have been fatal. Similar facts were observed before the war with certain touring cars. The mechanism of the poisoning is not quite simple, for the quantity of carbon monoxide mixed with the gas is minimal, although the lesions observed at autopsy point distinctly to carbon monoxide poisoning. The red blood cells were not destroyed nor was the hæmoglobin reduced in the researches made by the pharmacist, Major Ebren. Blood impregnated with hydrocarbons was found to be still capable of absorbing oxygen. The toxic action is more complex, and exerted apparently both on the respiratory apparatus and on the medulla. The early symptoms seemed to be due to a toxic action on the medulla. In view of these observations officers in charge of ambulances should observe great care in supervising carriages warmed in this way, and should direct the chauffeurs to assure themselves of the condition of the patients every time the motor functions badly.

Increase of Consultation Fees.

The Association of Medical Men in the Department of the Seine decided, at its last meeting, presided over by Dr. Leredde, to increase the standard of medical fees by 25 per

There is an apparent discrepancy at this point.

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cent. for all persons whose financial position has not been changed for the worse by the war. The increased charge is naturally aimed at the numerous patients whose position has been actually improved by war conditions. A merchant in any kind of wares may, by common consent, raise his prices in proportion to new charges which fall upon him, and the medical man unquestionably possesses the same right when he is mulcted by increased taxation. The doctors only desire to make their fees proportional to the situation of the people who claim their services. In ordinary times, be it remembered, they have always lost some 15 per cent. of fees in bad debts, which were for the most part unredeemable.

Reinforced Quinine Treatment of Malaria.

M. Carnot has dealt with this subject at a recent meeting of the Medical Society of the Hospitals, claiming that treatment is insufficient in many cases of recent malaria when quinine is administered by the mouth even in a dose of 1·5 gm. He insists on the great advantage of the intravenous route of administration, one or two ampoules, each containing 0·4 gm. of quinine and 0·2 gm. of urethane in 1 c.c. of water diluted to 20 c.c. with normal saline being injected. This combined method reinforces the action of quinine in pernicious forms of the disease, especially when these are afebrile.

Jan. 22nd.

THE SERVICES.

ROYAL NAVAL MEDICAL SERVICE.

To be temporary Surgeons: L. Baxter, N. S. Hewitt, W. O. Lodge, W. J. C. Watt, R. W. Pritchard, and J. P. Ross.

ROYAL ARMY MEDICAL CORPS.

To be temporary Lieutenant-Colonels: Sir Arthur Chance, A. B. Mitchell, and H. M. Rigby (Captain, R.A.M.C., T.F.).

Temp. Capt. C. D. Pye-Smith to be temporary Lieutenant-Colonel whilst in command of a Field Ambulance.

The undermentioned relinquish the acting rank of Lieutenant-Colonel on reposting: Major H. W. Long, Temp Capt. J. La F. Lauder, D.S.O., and Temp. Major C. E. Ligertwood.

Majors to be acting Lieutenant-Colonels whilst in command of a General Hospital: M. C. Wetherell and Arthur W. Gater.

To be Acting Lieutenant-Colonels whilst in command of a Casualty Clearing Station: Brevet Lieut.-Col. FitzG. G. FitzGerald and Major J. H. R. Winder.

Capt. A. M. Pollard to be acting Lieutenant-Colonel whilst in command of a Field Ambulance.

Capt. E. M. Middleton to be acting Major whilst in command of a Field Ambulance.

Lieutenants to be temporary Captains: C. E. A. Huddart, T. H. Oliver, J. Ross, J. B. Cheesman, D. K. MacDougall, H. F. Brice-Smith, G. S. Terry, J. P. O'Connor.

To be Lieutenants: Captain J. A. W. Ebden (R.A.M.C., Spec. Res.) with temporary rank of Captain, T. C. Bowie, G. C. Robieson, D. H. Coats, C. B. C. Anderson (R.A.M.C., Spec. Res.), P. E. D. Pank, G. Moulson, and R. H. C. Pryn (from R.A.M.C., Spec. Res.).

O. P. N. Pearn to be temporary Captain whilst employed at the Lord Derby War Hospital.

Temporary Captains relinquishing their commissions: O. P. N. Pearn, J. Hanson, A. H. R. Duncan, F. J. Dixon, F. McKee, R. G. Brown, R. D. Forbes, J. E. M. Brown, A. W. Anderson, H. H. Prentiss, N. I. Sinclair, J. A. K. Brayton, S. G. Billington, G. W. Charsley, E. C. A. Smith, P. J. S. O'Grady, F. G. O'Donohoe, N. R. Rawson, A. V. J. Harrison, F. S. Rowland, D. H. Griffiths, G. E. Genge-Andrews, E. E. Hobson, J. S. Hall, F. A. Murray, H. L. Apthorp, W. R. S. Watkins, T. J. Burton, P. Butler, J. E. Cook, J. Allan, R. B. Taylor, M. Haynes, J. S. Martin, J. Allison, H. S. Berry, H. Catling, G. Coats, R. S. Miller, F. Ayre (on account of ill-health).

Surgeon-Capt. A. J. Clarke (Overseas Contingent, B.W.I. Regiment) relinquishes his commission.

Temp. Hon. Capt. A. E. Ward, having resigned his appointment at the Springburn and Woodside Central Red Cross Hospital, relinquishes his commission.

Temporary Lieutenants relinquishing their Commissions: G. W. Racey, S. E. T. Snann, J. A. Davidson, A. Chance, H. S. Sims, R. M. Moore, R. Paterson, S. Denison (on account of ill-health).

SPECIAL RESERVE OF OFFICERS.

To be Lieutenants: G. G. Jack, D. Mitchell, H. C. Roberts, C. Tighe, B. Mountain (from University of London Contingent, O.T.C.), J. A. Charles, J. B. Leigh (from Manchester University Contingent, O.T.C.), W. B. Lawson.

Captains to be acting Lieutenant-Colonels whilst in command of a field ambulance: (Acting Major) R. Magill, W. H. L. McCarthy, W. R. Gardner.

TERRITORIAL FORCE.

Capt. W. A. Slater, from 1st Northern General Hospital, to be Captain.

Capt. K. B. Clarke relinquishes his commission on account of ill-health, and is granted the honorary rank of Captain.

Capt. C. A. Spooner is seconded for duty with a hospital abroad, and Capt. J. N. Robins is seconded while holding the appointment of Deputy Assistant Director of Medical Services.

John Steedman to be Lieutenant.

Lieuts. K. F. R. Davison, G. L. Findlay, and G. D. Newton to be Captains.

Major J. S. Mather relinquishes his commission on account of ill-health and is granted the honorary rank of Major.

Attached to Units other than Medical Units.—Major R. J. R. C. Simons relinquishes his commission on account of ill-health, and is granted permission to retain his rank and wear the prescribed uniform.

TERRITORIAL FORCE RESERVE.

Surgeon-Major C. O. Parsons, from Glamorgan R.G.A., to be Surgeon-Major.

DEATHS IN THE SERVICES.

Lieutenant-Colonel C. M. Thompson, I.M.S., on Dec. 24th, 1916. He entered the service in 1887 and served in the Tirah Expedition in command of the 44th N.F. Hospital, 3rd Brigade, was present at the actions of Chargu Kotal, Dargai, passage of Dargai Defile, Samagha Pass and took part in the operations in the Waran Valley and in the Bara in 1897 (medal and two clasps). Subsequently he was appointed Civil Surgeon at Ootacamund and later Staff Surgeon at Secunderabad, being appointed senior medical officer of the General Hospital, Madras, in 1909. He was Principal of the Madras Medical College until 1911. Since the commencement of the war and up to a year ago he was employed temporarily at the Home for Indian Soldiers, Barton-on-Sea.

VITAL STATISTICS OF ENGLAND AND WALES FOR 1916.

THE following statement shows the birth- and death-rates and the rates of infant mortality in England and Wales, and in certain parts of the country during the year 1916, the figures being provisional:—

—	Death-rate per 1000 living.*	Deaths under one year per 1000 births.
England and Wales	14·0	91
96 great towns, including London (populations exceeding 50,000 at the Census of 1911)	14·4	98
148 smaller towns (populations from 20,000 to 50,000 at the Census of 1911)	13·0	90
London	14·3	87

* The death-rate for England and Wales is based upon deaths in the whole population and an estimated total population of 36,250,000. The birth-rate is similarly calculated is 21·6 per 1000. The death-rates for the towns are based upon civil deaths and estimated civil population. The birth-rates cannot be stated. In all cases the population used relates to the year 1915.

URBAN VITAL STATISTICS.

(Week ended Jan. 20th, 1917.)

English and Welsh Towns.—In the 96 English and Welsh towns with an aggregate population estimated at nearly 18,000,000 persons the annual rate of mortality during the week was equal to 16·2, against rates steadily declining from 23·7 to 16·8 per 1000 in the four preceding weeks. In London, with a population of more than 4,000,000, the death-rate was 0·5, or 1·1 per 1000 below that in the previous week; among the remaining towns it ranged from 6·8 in Dewsbury, 9·7 in Wakefield, and 10·0 in Coventry, to 25·5 in Exeter, 26·6 in Oxford, and 27·9 in Bath. The principal epidemic diseases caused 238 deaths, which corresponded to an annual rate of 0·7 per 1000, and included 82 from measles, 59 from diphtheria, 56 from infantile diarrhœa, 24 from whooping-cough, 9 from scarlet fever, and 8 from enteric fever. The deaths from measles were 21 in excess of the average in the three preceding weeks, and caused a death-rate of 1·3 in Coventry, 1·5 in Birkenhead, and 3·7 in Wimbledon. The 812 cases of scarlet fever under treatment in the Metropolitan Asylums Hospitals and the London Fever Hospitals showed a further decline, while the 1396 cases of diphtheria were 1 in excess of the number at the end of the preceding week. Of the 5375 deaths from all causes in the 96 towns, 211 resulted from violence. The causes of 60 of the total deaths were uncertified, of which 20 were registered in Birmingham, 5 in Manchester, and 4 each in London and Liverpool.

Scotch Towns.—In the 16 largest Scotch towns, with an aggregate population estimated at nearly 2,500,000 persons, the annual death-rate was equal to 17·6, against rates declining from 19·6 to 18·1 per 1000 in the four preceding weeks. The 356 deaths registered in Glasgow were equal to an annual rate of 16·6, against 16·5 per 1000 in London, and included 7 from measles, 5 from infantile diarrhœa, 4 from whooping-cough, and 1 each from enteric fever and diphtheria. In Edinburgh the 108 deaths corresponded to an annual rate of 17·0 per 1000, and included 1 fatal case of whooping-cough and 1 of diphtheria.

Irish Towns.—The 187 deaths registered in Dublin were equal to an annual rate of 24·4 per 1000, and included 3 from measles and 1 each from scarlet fever, whooping cough, diphtheria, and infantile diarrhœa. In Belfast the 147 deaths corresponded to an annual rate of 19·5 per 1000, and included 7 from infantile diarrhœa, 5 from measles, 3 from whooping-cough, 2 from diphtheria, and 1 from enteric fever.

Correspondence.

"Audi alteram partem."

THE PROPHYLAXIS OF VENEREAL DISEASES.

To the Editor of THE LANCET.

SIR,—The critical and helpful articles that were published in THE LANCET and the *British Medical Journal* on Jan. 13th have led me to ask for space in your columns for a few remarks on this subject which, essentially medical though it is, is of high concern to the whole community. Since the appearance of my letter in the *Times* of Jan. 6th I have had numerous communications from various quarters indicating such concern, as well as a widespread conviction that medical men should make known to their patients generally those means of prophylaxis against venereal infections with which pathological science has in recent years supplied them. Up to now, however, although the public have been very generally and rightly instructed of late with respect to the multiform and dangerous results of syphilis and gonorrhœa, and also to the necessity of prompt treatment after these diseases have been contracted, a general silence has prevailed on the matter of prevention, not only on the part of the many lay members of the community who have earnestly and successfully promoted the important measures which have now found accomplishment, but also of the medical profession at large, inclusive of that special section of it which is devoted to the guardianship of the public health. The reason of this public attitude on the part of the medical profession generally—I am not forgetting the many individual medical men who are in no wise reluctant to aid in checking the spread of these infections by imparting their knowledge as freely as possible—is not far to seek. Medical men are hampered in this action by the "mediæval doctrine" which, though it may not be expressed in words, is still operative in leading the public to regard sexual diseases from a different standpoint from that which they maintain towards all others. While the more prominent and powerful lay promoters of the recent great advance made in informing the public of the dangers of venereal diseases decline to take notice of the paramount importance of preventing infection at its source, it is perhaps scarcely to be wondered at that the medical profession as a body has not entered into an undertaking which, without some encouragement, would at least be difficult and liable to miss a rapid success. It is undeniably true that neither moral nor religious instructions will succeed in the future any more than they have succeeded in long past centuries in checking to any considerable extent the gratification of sexual instinct in both sexes by "irregular intercourse."

The danger of venereal infection has been long held out as a phy-ical deterrent, but with little or no effect, and no adequate result in this direction can be expected from the more detailed accounts of these dangers that have lately been given to the public. However great the dangers, the fact remains that only a comparatively small proportion of either sex, with the exclusion of regular prostitutes, contract syphilis or, indeed, gonorrhœa; and thus the risk is constantly taken even by those who are well aware of what consequences are entailed by failure to escape infection.

In a private letter to me Sir James Crichton-Browne, who has granted my request to be permitted to use it as I like, says:—

> If syphilis were an inevitable *ordained* consequence of irregular sexual intercourse something may be said for leaving it alone; but as it is only a very occasional consequent it can be but feebly deterrent, if deterrent at all, and ought to be unhesitatingly prevented in every possible way. The prevention of syphilis and the prevention of immorality should be kept wholly distinct from each other. The Government have interdicted the sale of whisky less than three years old, the object being that in maturing it may be freed from the ingredients that produce injurious effects on the consumer. But, according to the opponents of the prevention of syphilis, that must be all wrong. The rawer the whisky—the more fusel oil in it, the better; so that men may be prevented from drinking by the dread of delirium tremens. I remember Lord Houghton's telling me that at the time of the discussion on the "Contagious Diseases Act" he had some conversation with Mrs. Butler. At last he said to her, "It seems to me that you regard the syphilitic virus as a beneficent moral agent. Now, tell me, if you had that virus locked up in a box and you had the key, would you keep it locked up or would you let it loose upon humanity?" Mrs. Butler vouchsafed no answer.

I wholly agree with the criticism in the *British Medical Journal* that effective measures of prevention must have regard to both sexes, "it being at least as likely that one infected woman will infect many more, as that one infected man will infect many women." This fact is ignored in much that has lately been spoken and written on this subject. The dissemination of the disease by the male has especially attracted attention now owing to the assumption, based, I suppose, on some ascertained facts, that large numbers of infected soldiers will return to this country during and after the war. It is on this assumption at least that a special plea of urgency for prompt and effectual treatment of the disease was put forward when financial aid from the State, for this purpose, was recently sought and successfully obtained. I do not hesitate in expressing my opinion that doctors not only are justified in spreading the knowledge we now possess of effectual prophylaxis in respect to venereal disease, but also are bound in duty to do so in view of their knowledge of the results of disease, and of their functions as promoters of the public health.

Suggestions have been made to me for the forming of an association of medical men and others with human interests for promoting the knowledge of effectual prophylaxis against venereal diseases; but it seems clear that an initiative in this direction would be taken with far better prospects of quick success at the present juncture, if not by the Local Government Board itself, by the existing Society of Medical Officers of Health. The question is, and should be, regarded as exclusively medical. The time has come for plain speaking and prompt action on the part of the medical profession. In the words of THE LANCET article, "preventive treatment is a logical step forward, and ought to be taken at once."—I am, Sir, your obedient servant,

Jan. 23rd, 1917. H. BRYAN DONKIN.

THE PHENOMENA OF ANAPHYLAXIS.

To the Editor of THE LANCET.

SIR,—I have read with the greatest interest and with much benefit Captain S. Wyard's excellent article on the phenomena of anaphylaxis in your issue of Jan. 20th, and, while I do not remember reading a clearer exposition of the subject, yet there are points not clear to me. It is the clinical point of view in which I am most interested.

In dealing with the sensitisation of man, Captain Wyard speaks of "considerable," "small," and "massive" doses of serum. He specifies what he means by a "small" dose, but he does not do so of the terms "considerable" and "massive." He says: "Persons receiving massive injections are not, or, at all events, not always, hypersensitive after six weeks." Again: "A massive first dose in many cases requires longer to produce hypersusceptibility than a smaller." Again: "The anaphylactic state after two or three small doses may still be absent 28 days after the last;" and again: "Until proof to the contrary is forthcoming, it must be assumed that anyone who has received one or more injections more than 14 days previously is in this state"—(susceptibility to anaphylaxis).

I am unable to follow him as precisely as I could wish, and I would be much obliged were he to help me, for I am not writing in a captious spirit. I feel sure he will excuse me when I say that his description of the phenomena of serum disease in man requires amplification. For example, he does not mention the circinate rash, which is next most common to the urticarial, and he says that the morbilliform rash is sometimes, but more rarely seen than the urticarial. As a matter of fact, nowadays the morbilliform rash bears no such comparison, for it is rare.

I am, Sir, yours faithfully,

FREDERIC THOMSON.

North-Eastern Hospital, Tottenham, N., Jan. 22nd, 1917.

To the Editor of THE LANCET.

SIR,—I have often wondered whether, in the case of severe immediate reaction of anaphylaxis, sufficient attention is given to the possibility of swelling of an urticarial type

in the larynx. A patient suffering from diphtheritic laryngitis was admitted to hospital under my care. Tracheotomy was performed and antitoxic serum given subcutaneously. The tube was removed later. Recovery was slow. Following on a treatment which was then being given trial, a second injection of serum was given about six weeks after the admission of the patient to hospital. Within a few minutes of the injection the patient (a small boy) developed an extraordinarily severe urticarial rash in practically all regions. At the same time typical signs of laryngeal obstruction were seen and the boy became very cyanosed. The tracheotomy wound was reopened and a tube inserted. All respiratory embarrassment disappeared at once. The simplest explanation seemed to be that the urticarial rash had extended to the larynx.

I should therefore certainly try the effect of tracheotomy if in a severe immediate reaction, accompanied by urticaria, a fatal result was threatening.

I am, Sir, yours faithfully,

Jan. 20th, 1917. MILES B. ARNOLD.

DEFINITION OF ACUTE ALCOHOLISM.

To the Editor of THE LANCET.

SIR,—I have read with interest Dr. W. C. Sullivan's letter on this subject in your issue of Jan. 20th and I gladly supplement the data of my original letter in the direction desired. I fear, however, that I can give no explanation of the curious paradox that the police figures for the Edinburgh area show an apparent material decrease of drunkenness among women, while the admissions into my wards of women suffering from acute alcoholism have more than doubled. This paradox is all the more remarkable because the conclusion indicated by the hospital figures, as to the great increase of drunkenness among women, is confirmed in the experience of the officials of the out-patient department where minor cases of alcoholism are dealt with, and also by all the collateral evidence obtained.

In reply to one query of Dr. Sullivan's, I may say that there has been no marked alteration in the type, and no change in classification, during the five years in which the wards in question have been under my care.

I have not looked into the point whether there has been any special change observed in the incidence of frankly declared delirium tremens. I attach little importance to this point. Delirium tremens is merely an incident in the development of *some* cases of acute alcoholism. I should say it is observed in from one-third to one-half of the cases admitted, the former figure being probably the more correct. By way of illustration, I may say that since reading Dr. Sullivan's letter I have taken the last ten cases of alcoholism admitted to my wards, since the 10th of this month, eight of which were brought in by the police; two of these only developed any symptoms of delirium tremens.

My experience leads me to doubt whether statistics of delirium tremens can be regarded as a useful and reliable means of gauging alcoholism in England; if the figures of the Royal Infirmary may be taken as typical of the rest of Scotland, I am satisfied they would not form a complete and reliable guide to sobriety in Scotland.

I am, Sir, yours faithfully,

Edinburgh, Jan. 22nd, 1917. CHALMERS WATSON.

A PLEA FOR THE GENERAL USE OF PNEUMATIC TOURNIQUETS.

To the Editor of THE LANCET.

SIR,—The usual method of arresting the circulation in the forearm and hand or the leg and foot during operations on these extremities by winding a tightly stretched piece of elastic tubing round the arm or thigh over a layer of gauze has certain disadvantages. The assistant may fail to apply the tourniquet with sufficient tightness to arrest the circulation, or, more often, the tube is applied with some roughness and so as to exert an unnecessary degree of compression. I have seen disappearance of the radial pulse persist for several days after the use of such a tourniquet on the arm of a young adult. The rubber tube must be applied before the towels are arranged and often some minutes before the first incision is made, and its release towards the close of the operation is often an inconvenient business. If vessels and nerves can be injured by this procedure in a young healthy subject, how much more serious is the danger in old patients with diseased and brittle arteries. Perhaps the occasional recurrence of gangrene in the flaps of an amputation undertaken for diabetic gangrene is due in no small measure to injury and thrombosis of the main artery at the site of the tourniquet.

The ordinary sphygmomanometer makes an excellent pneumatic tourniquet for use in operations below the middle of the thigh or arm. The pneumatic armlet is applied to the upper part of thigh or arm and the pressure raised and maintained for a moment to ensure that the apparatus does not leak. The administration of the anæsthetic is begun, the limb is raised to empty the veins, and the sterile towels arranged. When the surgeon is about to begin the armlet is inflated till 5 mm. of mercury above the maximum systolic pressure is registered by the manometer. A spring clip may then be applied to the tube coming from the inflating bulb to guard against any leakage through its valve. When the main vessels have been ligatured the pressure can be instantly lowered to enable the recognition of fine bleeding points, or as instantly raised again should the hæmorrhage be too free. A bicycle pump can be substituted for the usual inflating bulb with advantage.

To arrest the circulation at the level of the hip or the shoulder a special pneumatic band has to be constructed, but for the greater number of amputations or other operations on the extremities the ordinary sphygmomanometer, which is in the armamentarium of most doctors, suffices. Such a pneumatic tourniquet has the following advantages:—1. No violence can be caused by its application. 2. Only the minimum pressure required is employed. 3. The tourniquet can be brought into action or released easily and instantaneously and so need not be in force for a second longer than is necessary.

I am, Sir, yours faithfully,

KENELM H. DIGBY, M.B., B.S.Lond., F.R.C.S.Eng.,
Ho Tung Professor of Clinical Surgery, University of
Nov. 27th, 1916. Hong-Kong.

THE CAUSE OF TRENCH-FOOT.

To the Editor of THE LANCET.

SIR,—If wetness, leading to electrical changes, were the cause of trench-foot, as suggested by Mr. Nepean Longridge in your issue of Jan. 13th, warm water should cause the condition as much as cold water. Now, anybody who has observed rice-growing and waterside communities in the tropics will know that they do not suffer from trench-foot, though their feet are constantly wet.

I am, Sir, yours faithfully,

V. T. CARRUTHERS,
Jan. 18th, 1917. Captain, R.A.M.C.

THE TREATMENT OF TRENCH-FOOT.

To the Editor of THE LANCET.

SIR,—The experimental work of Lorrain Smith, Ritchie, and Dawson on rabbits suggests that in the affection known as trench feet the primary and most serious injury is sustained by the blood-vessels. They found in their experiments that the vessel walls had been seriously damaged; there was swelling of the intima and vacuolation of the cells of the muscle coat. There was also considerable exudate and the establishment of a condition of local stasis and œdema.

A large number of cases of trench feet have come under my care, and I have been struck by the fact that nearly all these patients complained of the pain which they endured at night. This symptom, combined with the obvious signs of local vaso-motor paralysis, led me to try the effect of affording external support to the relaxed vessels by means of crêpe bandages. In every case the relief from pain has been striking and immediate, and the progress of cases so treated has been rapid and satisfactory. The bandages should be applied so as to exert a firm but gentle pressure without causing constriction of the vessels, and, as a matter of practice, most patients speedily learn to adjust them for themselves. The entire foot should be bandaged, and the toes can best be included by first enclosing them in cotton-wool. If small patches of broken or ulcerated skin are present the bandages can be applied over the ordinary dressing.

This method of treating trench feet by crêpe bandages will be found most valuable in at once alleviating the pain which is so common a feature of this condition, and, while directly promoting the absorption of exudates, it has the advantage that it need not interfere with any of the usual methods of treatment by massage or electricity.

I am, Sir, yours faithfully,

GEORGE COOPER, B.A., M.D.,
Medical Officer in charge of Electro-therapeutic Department,
Jan. 20th, 1917. Royal Victoria Hospital, Netley.

MUNITION WORK AND CHILD WELFARE.

To the Editor of THE LANCET.

SIR,—In common with other districts throughout the country we have been making special efforts during the past few years for the improvement of child welfare and the protection of infant life. Much good has undoubtedly been done, but disappointment has been met with at times, and I have been impressed lately by the fact that munition work is becoming responsible in many cases for home neglect. This can hardly fail to follow if, as seems to happen frequently, the mother as well as the older daughters of a family spend the day at a munition factory. There is a large factory near here which offers tempting wages to every woman capable of work, and in some families, at any rate, the mothers of small children, together with the older girls, are now working there daily, leaving the younger children, including babies, to the care of girls, or even boys, of from 12 to 14, or to the casual charge of neighbours. The remedy would seem to be that before engaging mothers of families at munition works inquiry should be made, and that the mother should not be engaged unless she can show that some responsible woman is in charge of the children. Munition work is, of course, all-important, but if it be carried on at the expense of the young children of the nation the balance might work out ultimately on the wrong side. From a national point of view the mother's most important work is with her children.

I am, Sir, yours faithfully,

H. CAMERON KIDD,
Jan. 11th, 1917. Medical Officer of Health of Bromsgrove.

THE PREVENTION OF VENEREAL DISEASE.

To the Editor of THE LANCET.

SIR,—Your remarks upon this subject in the leading article in THE LANCET of Jan. 13th are of great practical moment. In venereal disease prevention is *the* treatment, as very few cases are actually cured. Time and money fail the sufferers, and so these pass into chronic states.

In 1907 I inquired into the German system of prevention, and after much trouble I obtained reliable information. It may be of interest now, and also a practical lesson to us, to state that in 1911 I wrote to the English consul in a leading German city asking him to find out all the facts relating to venereal prevention. He replied that he had inquired in "several competent quarters," and that he was "assured by naval officers of high standing that they knew nothing of such a system"! What ignorance! In 1912 I produced a small case containing drugs to prevent gonorrhœa, chancroid, and syphilis, spending about £50 upon this outfit. My idea was that the shipping companies would take it up, and—after the German plan—fix a slot machine, with the little tin cases inside, so that each seagoing man before going ashore could, by dropping in 1*s.* or less, obtain a reliable supply. I still hope that such slot machines will be fixed on each ship and at the various sailors' homes and other places.

When I was requested by the Liverpool S.S. Owners' Association to draft a report for presentation to the Venereal Commission, I described fully the system of prevention in various countries. This report was sent to the Commissioners, and also several of the little tin preventitive boxes. I regret the Commission did not recommend this suggestion. It is instructive—in this commercial country—that when I attempted to advertise it in so many of the medical and lay papers all refused to insert it! Now that "Mr. and Mrs. Grundy" have been suffocated, I am glad to see that my pioneer work is bearing practical results. The German system makes a marked mistake in attacking this big question *from the male side* only. The female must be taken in hand also, especially as it is now recorded that in certain U.S.A. (and other) cities the female prostitute is known to have not less than 30 male prostitutes *daily* having sexual relations with her. We are at the beginning only of this great national question of prevention of venereal diseases, and prevention is almost the only rational programme to adopt. It will give the best results of all.[1] I am, Sir, yours faithfully,

Liverpool, Jan. 20th, 1917. ROBERT R. RENTOUL.

THE NOMENCLATURE OF "INTERNAL SECRETION."

To the Editor of THE LANCET.

SIR,—Dr. Blair Bell adopts a method of controversy in which I cannot compete with him. I am content to let such epithets as "back-handed," "arrogant," and "vain-glorious" recoil upon the person who employs them.

I am, Sir, yours faithfully,

Edinburgh, Jan. 23rd, 1917. E. A. SCHÄFER.

THE OFFICIAL VISIT TO THE *FIELD* BUILDING.

To the Editor of THE LANCET.

SIR,—You will have seen a report published in the *Times* that my private room in the *Field* building had been officially visited under warrant from the War Office. Will you kindly grant me space to say briefly that this visit had no relation to any business of the *Field* newspaper and concerned only correspondence relating to a high explosive in which I am privately interested? I have stated the whole case in a long letter which the *Times* was good enough to print for me on Jan. 18th. I am, Sir, yours faithfully,

THEODORE A. COOK.
Windsor House, Bream's-buildings, E.C., Jan. 18th, 1917.

MASSAGE AND MEDICAL ELECTRICITY IN THE AFTER-TREATMENT OF CONVALESCENT SOLDIERS.

To the Editor of THE LANCET.

SIR,—I should like to emphasise particularly the efficacy of the following simple applications in the after-treatment of convalescent soldiers.

1. *Ionisation.*—Many of those cases in which the passage of shrapnel or bullets through a limb has produced considerable disorganisation of tissue, with resulting pain, stiffness, and weakness, are very greatly benefited by ionic medication. As a rule, sodium ions are useful for softening large hard scars, and iodine ions help in the absorption of fibrous masses; but in view of the fact that one often finds conditions suggestive of a slow infective process salicylic acid can often be employed with advantage as the ionising drug. A preliminary application of radiant heat will undoubtedly assist ionisation in many instances.

2. *Spinal galvanism.*—For a number of men suffering from the nervous irritability, hypersensitiveness, and indefinite muscular pains which are not infrequently met with in the convalescent stages of war neurasthenia, the descending galvanic current applied with the anode over the cervical spinal region and each foot placed in a small bath, and the baths both connected to the negative pole, gives excellent results. I have been struck by the way in which the men themselves have spoken appreciably of this treatment, which may be varied by using a combined galvano-faradic (or galvano-sinusoidal) current.

3. *Static electricity.*—For the treatment of shell shock after the initial stages I cannot speak too highly of the static apparatus. Where there are irritability, restlessness, disturbed sleep, and headache, I have found simple charging—with the patient on an insulated platform connected to the negative pole whilst an electrode is adjusted to give a gentle head-breeze—an invaluable method.

May I also point out the desirability of medical men in general practice keeping in touch with various electro-

[1] Those practically interested will find a reference to systems in force in my essay, The Prevention of Enthetic Diseases (Booksellers Co., 72, Ford-street, Liverpool, 2*s.* 1*d.*).

therapeutic measures that are being successfully carried out in the treatment of the convalescent wounded, for it is certain that they will ultimately have to deal with a number of cases requiring treatment of this kind and it will be most unfortunate if these drift into the hands of unqualified "medical electricians."

I am, Sir, yours faithfully,

EDWIN L. ASH, M.D. Lond.,
Physician and Neurologist to the City of London Red Cross Hospital.

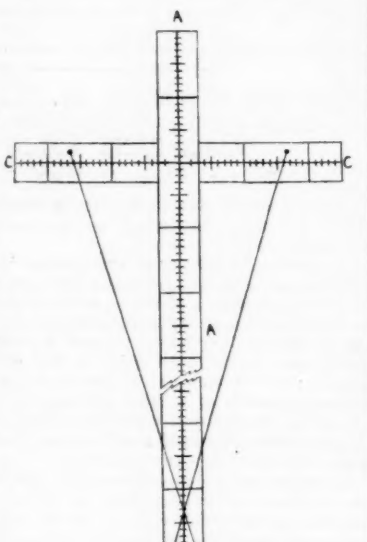
Harley-street, W.

THE LOCALISATION OF FOREIGN BODIES.

To the Editor of THE LANCET.

SIR,—In the hope that it may prove of use to anyone similarly situated to myself I venture to enclose a brief description of an adaptation of the Mackenzie-Davidson principle of localisation of foreign bodies which I devised for my own use. My X ray apparatus, which is one ordered by the Civil Administration of the Nyasaland Protectorate, was not equipped with a localiser of any description, and as there are practically no facilities for elaborate workmanship in Central Africa my own model is naturally rather a crude article.

The apparatus is shown in the accompanying figure. It consists of a length of hard wood, A, 3 feet long, graduated on the face in inches and, or, centimetres. At the lower end is fixed a crossbar, B, 18 inches long, at right angles to A, and similarly graduated. A similar crossbar, C, is arranged to slide on A over its entire length. The centre line of B represents the plane of the X-ray plate, and that on C represents the plane of the tube-anticathode. After marking the skin directly over the incident ray by any of the usual methods, move the tube—say 3 inches—to the left of the centre position and expose the plate; then move the tube 3 inches to the right of the centre position—that is, 6 inches in all—and make a second exposure on the same plate, thus obtaining two shadows of the foreign body on the one plate. Now set the centre line of crossbar C at a distance from the centre line of crossbar B equal to the distance of anticathode from the plate. Measure the distance between the two shadows on the plate—say this is 3 inches. Now by setting the two threads on C from 3 inches to the right and left of the centre line of A, representing the traverse of the tube, to 1½ inches to the left and right of the centre line of A on B, representing the distance between shadows, the depth from the plate, of the foreign body can be read off direct by noting where the threads cross the centre line of A. The threads shown in the figure are fastened by means of drawing-pins.



This method will be found simple, rapid, and sufficiently accurate for all but the most delicate of work. The illustration is not drawn to scale, but will serve to illustrate the principle of operation.—I am, Sir, yours faithfully,

PERCY PERROW,
Lieutenant, S.A.M.C.; Radiologist, Nyasaland Field Force.

Dec. 8th, 1916.

The War.

THE CASUALTY LIST.

THE following names of medical officers appear among the casualties announced since our last issue:—

Died.

Surgeon C. E. Reckitt, R.N., was a student at Guy's Hospital, London, and qualified in 1913. He had held appointments at Guy's and at the Royal Infirmary, Hull.

Wounded.

Capt. F. B. Simpson, R.A.M.C.
Capt. W. D. Reid, R.A.M.C., attached Manchester Regiment.
Capt. C. M. Forster, R.A.M.C., attached Yeomanry.

THE HONOURS LIST.

The following promotions of and awards to medical officers are announced:—

G.C.B.

Surg.-Gen. Sir A. Keogh, K.C.B. (ret. pay).

K.C.B.

Surg.-Gen. W. Donovan, C.B. (ret. pay); Col. (temp. Surg.-Gen.) N. R. Howse, V.C., C.B., Australian A.M.C.

C.B.

Surg.-Gen. W. W. Kenny (ret. pay); Col. E. North (ret. pay), A.M.S.; Col. W. H. Horrocks, A.M.S.; Col. D. J. MacKintosh, M.V.O., A.M.S. (T.F. Res.), Col. C. C. Reilly, A.M.S.; Col. J. Thomson, A.M.S.; Surg. Lt.-Col. P. J. Freyer, ret., I.M.S.; Lt.-Col. T. H. Openshaw, C.M.G., R.A.M.C. (T.F.); Lt.-Col. H. G. Barling, R.A.M.C. (T.F.); Lt.-Col. H. Davy, R.A.M.C. (T.F.); Temp. Lt.-Col. Sir T. Myles, R.A.M.C.; Temp. Lt.-Col. Sir W. A. Lane, Bart., R.A.M.C.; Temp. Lt.-Col. J. Swain, R.A.M.C.; Temp. Lt.-Col. W. A. Turner, R.A.M.C.; Temp. Lt.-Col. Sir B. G. A. Moynihan, R.A.M.C.; Temp. Lt.-Col. (temp. Col.) R. Jones, R.A.M.C.

K.C.M.G.

Surg.-Gen. G. D. Bourke, C.B. (ret. pay).

C.M.G.

Lt.-Col. W. W. Pope, late R.A.M.C.; Lt.-Col. G. E. Twiss (ret. pay), late R.A.M.C.; Lt.-Col. H. E. B. Bruce-Porter, R.A.M.C.; Lt.-Col. G. B. Stanistreet, R.A.M.C.; Lt.-Col. (temp. Col.) R. S. H. Puhr, D.S.O., R.A.M.C.; Lt.-Col. (temp. Col.) H. P. W. Barrow, R.A.M.C.; Temp. Hon. Lt.-Col. J. L. Thomas, C.B., R.A.M.C. (Maj., ret., T.F.); Maj. G. L. Gulland, R.A.M.C.; Col. Hon. W. E. Collins, New Zealand Medical Corps.

To be Brevet Colonels.

Lt.-Col. H. A. Haines, R.A.M.C.; Lt.-Col. C. J. Jacomb-Hood, 2nd Eastern General Hospital, R.A.M.C. (T.F. Res.).

To be Brevet Colonel on Retired List.

Lt.-Col. A. W. Browne (ret. pay), late R.A.M.C.

To be Brevet Lieutenant-Colonels.

Maj. (temp. Lt.-Col.) B. A. Craig, R.A.M.C.; Maj. F. McLennan, R.A.M.C.; Maj. (temp. Lt.-Col.) A. H. Safford, R.A.M.C.; Maj. (temp. Lt.-Col.) C. R. S. Bradley, R.A.M.C., commanding Training Centre.

To be Brevet Majors.

Capt. A. E. G. Fraser, R.A.M.C.; Capt. (temp. Maj.) R. W. D. Leslie, R.A.M.C.

Military Cross.

Capt. H. V. Stanley, R.A.M.C.

MENTIONED IN DESPATCHES.

Lieutenant-General the Hon. J. C. Smuts, K.C., Commander-in-Chief of the East African Forces, in a lengthy despatch dealing with the campaign in East Africa since March last, says: "The work of the medical units has been very heavy, and all ranks have done their utmost in their care of sick and wounded, and in arranging for their speedy evacuation."

OBITUARY OF THE WAR.

RODERICK CAMPBELL McLEOD, M.D. NEW YORK,
LIEUTENANT-COLONEL, CANADIAN ARMY MEDICAL CORPS.

The death of Lieutenant-Colonel R. C. McLeod occurred at Bramshott Camp, Jan. 4th, under conditions both tragic and startling. He succumbed, after 24 hours' illness, to an anthrax infection communicated by a shaving-brush through a trifling razor abrasion on the face. Colonel McLeod was a Nova Scotian, a Scotch Highlander by extraction and very near in instincts and character to the parent stock. He was born in Cape Breton Island in 1867 and practised his profession in his native island. In December, 1915, he gave up his private work and went to Halifax to offer himself to the Canadian Army Medical Corps. When the University of St. Francis Xavier, a Catholic University in Nova Scotia, proposed offering a medical unit to the Government, he was selected to forward the project and afterwards to command the unit. It was known as No. 9 Stationary Hospital, C.E.F. In October of last year Colonel McLeod, with his unit, took charge of Bramshott Military Hospital, and to the discharge of this duty he was giving his best endeavours when the fatal accident occurred.

DEATHS AMONG THE SONS OF MEDICAL MEN.

The following sons of medical men must be added to our lists of those who have fallen during the war:—

Private W. N. Archibald, Royal Fusiliers, elder son of Major W. N. Archibald, R.A.M.C.
Capt. L. Porter, Royal Flying Corps, son of Capt. D. Porter, R.A.M.C.
Capt. O. C. Ward, Indian Infantry, second son of the late Major E. C. R. Ward, R.A.M.C.
Private P. B. Barlow, Grenadier Guards, youngest son of Sir T. Barlow, Bart., K.C.V.O., late President of the Royal College of Physicians of London, of Wimpole-street, London.
Surgeon C. E. Reckitt, R.N., elder son of Colonel J. D. T. Reckitt, R.A.M.C.

RED CROSS WORK IN THE COUNTY OF LONDON.—The December report of the work done by the London Divisions of the Red Cross Society makes very satisfactory reading, though there is still need for more adequate provision for training in Red Cross subjects. Of 112 candidates examined during the month 26 failed in first-aid, 22 in home nursing, and 2 in hygiene and sanitation, the greater number of passes being in first-aid—namely, 273. Owing, perhaps, to press of work, local secretaries do not in some cases supply their reports as promptly as the smooth working of the organisation demands. To meet this and other difficulties arrangements are being made to inspect systematically the work of each division.

THE WELFARE OF WOMEN WORKERS.—At the Mansion House on July 22nd the Lord Mayor presided at a meeting organised by the Young Women's Christian Association with the object of providing rest and recreation huts for women employed in munition works. Dr. Addison, in appealing for funds, said that Feb. 27th would be a Woman's Day in London, and he hoped that the large sums of money which were much needed for the work which the Young Women's Christian Association was organising would be forthcoming. It had been proved, he said, that there were few occupations that women were not capable of entering and already 900,000 women were acting as substitutes for men in the industrial work of the country, 500,000 being engaged in the production of munitions, a number which was increasing by 34,000 a month. He believed that the work undertaken by the Young Women's Christian Association, properly handled and wisely administered, would provide a basis for an organisation that would endure after the war and come to be regarded as an essential concomitant of our industrial life.

SCOTTISH WOMEN'S HOSPITALS: CALCUTTA UNIT.—As a result of a collection inaugurated on St. Andrew's Day a donation of £13,000 has been sent from Calcutta to the offices of the Scottish Women's Hospitals, 2, St. Andrew-square, Edinburgh, for the equipment and maintenance of a Calcutta unit.

REST-HOUSE FOR SAILORS AND SOLDIERS.—Major-General Sir Francis Lloyd, in opening the St. Peter's Rest House for Soldiers and Sailors on Jan 22nd at 4, Eccleston-square, S.W., referred to the difficulties of the authorities in finding accommodation for sailors and soldiers derelict in London, and paid a warm tribute of praise to the public institutions which had provided the necessary accommodation. Societies such as the Young Men's Christian Association, the Church Army, and the Salvation Army have now made available nearly 10,000 beds for men coming from the front.

THE SUPPLY OF WINE TO THE FRENCH SOLDIER.—It is stated that the French Government has requisitioned for the purposes of the Army a very substantial proportion of the vintage production. In France, therefore, wine has assumed a military importance, for no less than 200,000,000 gallons of wine from the country, together with 40,000,000 gallons from her Algerian colony, have been reserved for the use of the soldier. It would appear that each officer and man receives daily half a litre of wine. This allowance has been adopted since the war began, and the authorities are convinced that it has contributed to the health and efficiency of the troops through a campaign conducted under very trying conditions. The reasonable consumption of the wine of the country (*vin ordinaire*) is evidently regarded as beneficial rather than demoralising.

Obituary.

DUNCAN BURGESS, M.A., M.B. CANTAB., F.R.C.P. LOND.,

PROFESSOR OF MEDICINE IN THE UNIVERSITY OF SHEFFIELD AND CONSULTING PHYSICIAN TO THE SHEFFIELD ROYAL INFIRMARY.

WE regret to announce the death of Dr. Duncan Burgess, which took place at his residence in Sheffield on Jan. 17th.

Born at Grantown-on-Spey in 1850, Duncan Burgess received his early academic training at the University of Aberdeen, where, at an early age, he took the degree of Master of Arts. Proceeding to Cambridge, he became 13th Wrangler in 1875, and later was elected a Fellow of Corpus Christi College. Adopting then a medical career, in 1882 he became M.B. Cantab., obtaining, five years later, the Membership, and in 1905 the Fellowship, of the Royal College of Physicians of London.

He came to Sheffield in 1887, and was for many years physician to the Sheffield Royal Hospital, retiring as senior physician on reaching the age-limit in 1915. At Sheffield he occupied a prominent place in the academic world. He was for a long period lecturer on medicine at University College and later became professor of medicine in the University, while he was for some years the energetic secretary of the Sheffield Medico-Chirurgical Society. In 1890 he was deputed by the society, with Dr. W. S. Porter, to visit Germany and report on Koch's tuberculin treatment, and in 1899 was President.

At the outbreak of war he was mobilised with the rank of Lieutenant-Colonel, and acted for nearly two years as officer in charge of the Medical Section of the 3rd Northern General Hospital (T.F.). There is no doubt that the arduous work in connexion with his military duties brought on the fatal illness.

A personal friend writes:—

By the death of Dr. Duncan Burgess the profession in Sheffield has lost a loyal friend and an able and gifted colleague. To the younger men in the profession he never failed when the opportunity arose to hold out a helping hand. To all he was genial and kindly, and he succeeded in winning the affection in no small measure of patients and colleagues alike. In his profession a deep reader and keen critic, beyond it he possessed a wide knowledge of literature and a sympathetic interest in men and affairs. A great *raconteur*, a great lover of his native Scotland, an ideal host—for these things, hardly less than for his professional attainments, he was esteemed by those who knew him.

GEORGE MUNRO SMITH, M.D. BRISTOL (HON. CAUSA)

LIEUTENANT-COLONEL, R.A.M.C. (T.); CONSULTING SURGEON TO BRISTOL ROYAL INFIRMARY.

Dr. Munro Smith, who died at his home in Clifton on Jan. 13th after a long and painful illness, was in his sixty-first year. He was the son of a surgeon, and was educated at Clifton College and University College, London, returning to Bristol after obtaining the Conjoint Board qualification, where he was in succession medical tutor, demonstrator of physiology, and demonstrator of morbid anatomy. In 1893 he accepted the chair of physiology at Bristol University College, and in this capacity was one of the pioneers in the formation of the University of Bristol, which recognised his services by making him honorary M.D in 1912. From 1883 he occupied public surgical posts, first at the Orthopædic Hospital, then at the Royal Infirmary, where he became full surgeon in 1897, and Clifton Dispensary. Outside his many teaching appointments Dr. Munro Smith was active as President of the local branch of the British Medical Association, of the Bristol Naturalists' Society, and for a time of the Medico-Chirurgical Society. His many-sided career brought him into intimate relation with his colleagues, among whom, and especially the undergraduates, he was a popular figure.

THE LATE MR. C. M. BRADY.—Mr. Charles Matthew Brady, L.R.C.S.I., who died with tragic suddenness on Jan. 19th on his way to the Wigan Infirmary, where he was consulting surgeon, was one of the best known medical men in the Wigan district. After qualifying in Dublin he was for a short while in practice in Oxford before making his home for 35 years in the Lancashire manufacturing town. Mr. Brady was a member of the Borough Insurance Committee and sat for some years on the School Board. He was aged 62 years and leaves a widow and three children.

Medical News.

ROYAL COLLEGE OF PHYSICIANS OF EDINBURGH, ROYAL COLLEGE OF SURGEONS OF EDINBURGH, AND ROYAL FACULTY OF PHYSICIANS AND SURGEONS OF GLASGOW.—The examinations of this Board were concluded at Edinburgh on Jan. 20th, with the following results:—

FIRST EXAMINATION.

Sayed Chaleb and Arthur Henry Jacobs.

Physics.—Catherine Millar, John Rorrison McCubbing, Alexander Clon Thom, Robert Charles Dow, James MacClashan, and John Lister Redcliffe Ross.

Biology. Robert Charles Dow.

Chemistry.—John Rorrison McCubbing.

SECOND EXAMINATION.

Andrew Wood Smith, Gwilym ap Vychan Jones, Thomas Richard O'Keeffe Alexander Forsyth Caddell, George Michie Raeburn, Norman Joseph Patterson, Thomas Hall James Douglas, and Jatindra Kumar Sen.

Anatomy.—Robert Berry Forgan, Janet Adeline Agnes Sang, Lizzie Robertson Clark, and Thomas Arnoldus du Toit.

Physiology.—William Harvie Kerr and Walter Granville Carew.

THIRD EXAMINATION.

Hugh Emile Colman Collins, William O'Gorman Donoghue, Cecil Stuart Baxter, Andrew Francis Brigmen, Hassan Amin Madwar, John Kohler Steel, and Arthur Stanley Hughes.

Materia Medica.—Eduard Louis Adendorff, John Vaughan Griffith, Jung Bahadur Singh, Thomas Blaney, and John Haldane Bain.

FINAL EXAMINATION.

The following candidates having passed the Final Examination were admitted L.R.C.P. Edin., L.R.C.S. Edin., L.R.F.P. & S. Glasg.:—

William Fidler Mason, John Alexander Tolmie, James Wallace Gordon, Robert Frederick Claude Hamilton Buchanan, Alfred Black, Yeshwant Narayan Kadam, John Berry, Alfred David Gorman, and Wendell Thomas Garretson.

Medicine.—Russell Nelham Burton, Frederick Joseph Jack, Mary Gray Jones, and Jackson Baird Minford.

Surgery.—Don Adrian Jayasinghe.

Midwifery.—Benjamin Ajavi-Young, Robert Cloag Battersby, Alfred Edwin Elliott, Frederick Joseph Jack, and George Alexander Grandsoult.

Medical Jurisprudence.—Albert Ernest Hempleman, Allan Paul McLeod, Robert Pollok, Joseph Michaelson, Arukatti Patabendige Frederick Abeysuriya, John Lavens West, Andrew Inglis Meek, Donald Stewart, Frederick Joseph Jack, and Daniel Cornelius Howard.

IN order to increase the amount of barley, sugar, and other brewing ingredients available for food, Lord Devonport has proposed a further restriction of the output of beer to 70 per cent. of the present output, that is to say, to 50 per cent. of the pre-war figure. The War Cabinet has approved the proposal, and decided on a corresponding restriction on the release of wines and spirits from bond. A Bill confirming this decision will be introduced in the coming session of Parliament.

A SPECIAL introductory medical course in physics, chemistry, and biology for students desirous of beginning their medical studies will be held at University College, London, and will begin on March 1st. Intending students should communicate forthwith with the secretary, University College, Gower-street, London, W.C.

THE Council of the London and Counties Medical Protection Society, Ltd., at their meeting on Jan. 17th, decided to apply for £9,500 £5 per cent. War Loan (£2100 new money), bringing the amount of the society's investment in war securities up to £10,000.

ROYAL SOCIETY OF ARTS.—On Tuesday afternoon next, Jan. 30th, a paper on Imperial Industries After the War will be read by Mr. Octavius C. Beale, Representative and Past-President of the Australian Associated Chamber of Manufacture, to the Colonial Section of the Society. The chair will be taken at 4.30 o'clock by Mr. Long, Secretary of State for the Colonies.

CENTRAL MIDWIVES BOARD.—A meeting of the Central Midwives Board was held at Queen Anne's Gate Buildings, Westminster, on Jan. 18th, with Sir Francis H. Champneys in the chair. Correspondence was considered with the matron of an institution recognised by the Board as a training school for midwives with reference to the examination schedules of two candidates on whose behalf she had signed the certificates of training certifying that they had undergone a course of training in midwifery extending over a period of six months, when in fact their training had then extended over a period of less than five months, as she well knew. The Board decided that the institution be informed that the Board takes a very serious view of the signing of untruthful certificates; that in the present case there is no question that the action of the matron was due to an "oversight" or that "it was unintentional"; that the Act of Parliament (Sect. XII.) provides penalties of 12 months' hard labour for this offence; that the offence is aggravated by the fact that the institution is one from which the Board might have expected a high standard of honour; that the Board, in view of the gravity of the offence, postpones judgment until its next session.—A letter was considered from the town clerk of Middlesbrough enclosing a copy of a communication addressed by the coroner of Middlesbrough to the medical officer of health, stating that at an inquest held by him on Oct. 12th, 1916, on the body of a new-born child, the jury had added a rider to their verdict expressing the view that a midwife should not be allowed to notify as stillborn a child born before her arrival in a case where no registered medical practitioner was in attendance at the time of birth. The Board decided that the town clerk of Middlesbrough should be thanked for his letter, and be informed that the Board has noted the suggestion conveyed in the rider of the coroner's jury for consideration on the next revision of the Rules.—At a special meeting of the Central Midwives Board held on Jan. 19th, a number of midwives were struck off the Roll for various charges.

CENTENARIANS.—On Jan. 17th, the 100th anniversary of his birth, Mr. David Lewis, a liveryman and pensioner of the Glaziers' Company and the oldest City pensioner, was presented by the Company with a framed and illuminated copy of a resolution of congratulations passed by the Court at its last meeting, together with a gift of one hundred crowns. Mr. Lewis, who lives at Seven Kings, enjoys good health.—The King has sent a telegram of congratulation to Mrs. Arthur Mozley, of Malvern View, Cheltenham, who has completed her 102nd year.—Mrs. Ann Morrison, of Gairloch, has just completed her 103rd year.

MEMORIAL TO THE LATE MR. R. L. SWAN.—A committee has been formed to collect subscriptions to found a memorial to the late Robert L. Swan, Past-President of the Royal College of Surgeons in Ireland, and for many years surgeon to Dr. Steevens' Hospital and to the Orthopædic Hospital. The latter institution he helped to found in 1876. The precise form of the memorial has not yet been decided upon, but it is intended that it should be associated with the two institutions to which he had devoted so much of his life. The honorary secretary and treasurer of the memorial fund is Dr. T. Percy C. Kirkpatrick, of 11, Fitzwilliam-place, Dublin.

Appointments.

Successful applicants for vacancies, Secretaries of Public Institutions, and others possessing information suitable for this column, are invited to forward to THE LANCET *Office, directed to the Sub-Editor, not later than 9 o'clock on the Thursday morning of each week, such information for gratuitous publication.*

CAMPBELL, MALCOLM, M.D. Glasg., has been appointed Medical Officer of Health for Droitwich.

GALE, A. K., L.R.C.P., M.R.C.S., Consulting Medical Officer, and LUTHER, S., Assistant Resident Medical Officer to the Ecclesall Bierlow Union.

HARRIS H. G., M.D. Durh., one of the Medical Referees under the Workmen's Compensation Act, 1906, for County Court Circuit No. 51.

JACKSON, W., M.D. Brux., F.R.C.P.S. Glasg., Medical Officer for the Nelson Medical District by the Burnley Board of Guardians.

PENNINGTON, LOUISE A., House Surgeon at the Wolverhampton General Hospital.

PERRY, S. H., M.R.C.S., L.R.C.P. Lond., Temporary Medical Officer of Health for Spalding.

Vacancies.

For further information regarding each vacancy reference should be made to the advertisement (see Index).

When the application of a Belgian medical man would be considered the advertisers are requested to communicate with the Editor.

BARNSLEY, BECKETT HOSPITAL AND DISPENSARY.—House Surgeon. Salary £200 per annum, with board, &c.

BATH, EASTERN DISPENSARY.—Resident Medical Officer. Salary £140 per annum, with furnished rooms, &c.

BATH, WINSLEY SANATORIUM.—Assistant Resident Medical Officer. Salary £250 per annum, with board, &c.

BIRMINGHAM CITY.—Female Doctor for Infant Welfare Work. Salary £360 per annum.

BIRMINGHAN CITY EDUCATION COMMITTEE.—Temporary Assistant School Medical Officer. Salary £300 per annum.

BRISTOL GENERAL HOSPITAL.—House Surgeon for six months. Salary at rate of £175 per annum, with board, &c.

BRITISH RED CROSS HOSPITAL, Netley.—Pathologist, Junior Operating Surgeon, and Radiographer.

CAMBRIDGE, ADDENBROOKES HOSPITAL.—Honorary Assistant Surgeon in Out-patients' Department.

CHESTERFIELD AND NORTH DERBYSHIRE HOSPITAL.—Second House Surgeon. Salary £200 per annum, with board, &c.

COVENTRY EDUCATION COMMITTEE.—Temporary Assistant School Medical Officer. Salary £360 per annum.

ESSEX, ADMINISTRATIVE COUNTY.—Tuberculosis Officer. Salary £500 per annum.

GRIMSBY AND DISTRICT HOSPITAL.—House Surgeon. Salary £5 5s. per week, with board, &c.

HOSPITAL FOR SICK CHILDREN, Great Ormond-street, London, W.C.—House Surgeons, Assistant Casualty Medical Officer, and House Physician, unmarried. Salary at rate of £60 per annum each, with board, &c.

LEAMINGTON SPA, WARNEFORD AND SOUTH WARWICKSHIRE GENERAL HOSPITAL.—Second Resident Medical Officer. Salary £200 per annum, with board, &c.

NOTTINGHAM AND MIDLAND EYE INFIRMARY.—Female House Surgeon. Salary £120 per annum.

PORTREE, Island of Skye.—Parish Medical Officer and Public Vaccinator. Salary about £480 per annum.

ROYAL FREE HOSPITAL, Gray's Inn-road, W.C.—Radiographer and Medical Electrician.

SCOTLAND, NAVAL AUXILIARY HOSPITAL.—Assistant Surgeon and Medical Officer. Salary £1 per day, with board, &c.

SHEFFIELD UNION HOSPITAL, Firvale.—Female Resident Assistant Medical Officer. Salary £250 per annum, with rations, &c.

STAFFORDSHIRE, WOLVERHAMPTON, AND DUDLEY JOINT COMMITTEE FOR TUBERCULOSIS, MOXLEY SANATORIUM, near Wednesbury, Staffs.—Resident Medical Officer. Salary £450 per annum, with board, &c.

STANNINGTON, NORTHUMBERLAND, CHILDREN'S SANATORIUM.—Female Resident Medical Officer. Salary £200 per annum, with board, &c.

SUNDERLAND ROYAL INFIRMARY.—Female House Surgeon. Salary £150 per annum, with board, &c.

UNIVERSITY OF LONDON.—External Examiners.

WEST HAM UNION SICK HOME, 95, Forest-lane, Forest Gate, E.—Resident Assistant Medical Officer. Salary £300 per annum, with usual residential allowances.

WIGAN, ROYAL ALBERT EDWARD INFIRMARY AND DISPENSARY.—Resident Surgical Dresser.

WILTS COUNTY COUNCIL, GENERAL EDUCATION COMMITTEE.—Assistant Medical Officer as School Oculist. Salary £350 per annum, &c.

THE Chief Inspector of Factories, Home Office, London, S.W., gives notice of vacancies for Certifying Surgeons under the Factory and Workshop Acts at Bridport, Dorset; Wells, Somerset; and Chester le-Street, Durham.

THE Secretary of State for the Home Department, Whitehall, S.W., announces a vacancy for a Medical Referee under the Workmen's Compensation Act, 1906, for County Court Circuit No. 4.

Births, Marriages, and Deaths.

BIRTHS.

BARROW.—On Jan. 4th, at Bishopton, Lochgilphead, Argyll, the wife of Surgeon Murray Barrow, R.N., of a son.

BROWN.—On Jan. 12th, at Kasauli, Punjab, India, the wife of H. C. Brown, Major, I.M.S., of a daughter.

HALE.—On Jan. 19th, at Cambridge-square, W., the wife of R. E. V. Hale, M.B., of a daughter.

KENNARD.—On Jan. 16th, at Bedford-squre, W.C., the wife of Mr. Dudley Kennard, F.R.C.S., of a daughter.

WILSON.—On Jan. 15th, at Ritherdon-road, Balham, the wife of Maurice O. Wilson, Captain, R.A.M.C., of a daughter.

MARRIAGES.

NICHOLLS-BARRY.—On Jan. 20th, at St. Margaret's, Westminster, T. B. Nicholls, Lieutenant-Colonel, R.A.M.C., to Margaret, eldest daughter of Walter Barry, of Sutton, Surrey.

SMYTHE WOOD.—On Jan. 16th, at the Parish Church, Clifton, Gerald Arthur Smythe, Captain, R.A.M.C., to Sarella Mary Mackenzie, third daughter of Mr. and Mrs. Robert Ley Wood, formerly of Cheltenham.

WICKENDEN-HUNTER.—On Jan. 17th, at St. Stephen's Church, Perth, Stanley Wickenden, M.R.C.S., L.R.C.P. Lond., Captain, R.A.M.C. (S.R.), to Mary Stewart, daughter of Mr. and Mrs. Robert Hunter, of St. John's, Perth.

DEATHS.

BURGESS.—On Jan. 17th, at 442, Glossop-road, Sheffield, Duncan Burgess, M.B., F.R.C.P., aged 66 years.

HUGHES.—On Dec. 18th, 1916, in Northern Assam, David E. J. S Hughes, M.R.C.S., L.R.C.P. Lond., aged 30 years.

MEIKLE.—On Jan. 22nd, at Edinburgh, Thomas Christopher Meikle, Fleet-Surgeon, R.N. (retired).

RECKITT.—On Jan. 20th, at Royal Naval Hospital, Haslar, Charles Edward Reckitt, Surgeon, R.N., aged 30 years.

N.B.—A fee of 5s. is charged for the insertion of Notices of Births, Marriages, and Deaths.

METEOROLOGICAL READINGS.

(Taken daily at 8.30 a.m. by Steward's Instruments.)

THE LANCET Office, Jan. 24th, 1917.

Date.	Rain-fall.	Solar Radio in Vacuo.	Maximum Temp. Shade.	Min. Tem.	Wet Bulb.	Dry Bulb.	Remarks.
Jan. 18	...	42	39	34	34	35	Overcast
,, 19	0·03	39	39	35	36	37	Raining
,, 20	...	35	35	33	33	33	Raining
,, 21	...	34	34	33	34	34	Overcast
,, 22	...	37	36	31	32	32	Overcast
,, 23	...	43	35	32	31	32	Cloudy
,, 24	...	37	33	31	31	32	Snowing

Other information which we have been accustomed to give in these "Readings" is withheld for the period of the war.

Notes, Short Comments, and Answers to Correspondents.

THE ORGANISATION OF THE MEDICAL PROFESSION FOR WAR.

WE have received from Mr. K. M. Beavis, B.A., assistant secretary to the National Medical Union, 346, Strand, London, W.C., the following statement on the instruction of the Chairman of the Council of the Union:—

In view of the somewhat alarmist and as they think misleading statements appearing in the press on the above subject, the Council of the National Medical Union at their meeting held on Saturday, Jan. 13th, considered the alleged difficulty in meeting the medical needs of the country, both civil and military. The term "mobilisation" in the sense of the suggestions so far made appears to be synonymous with the conscription of a particular body of citizens who are more than warned that any lack of spontaneous alacrity on their part in offering their services for disposal according to the wisdom of a certain Central Medical War Committee will be followed by compulsory legislation, and the ousting of native by imported foreign medical service so far as the civil population is concerned. Considering the whole-hearted response to the country's need which has characterised the medical profession in this crisis, a response which has frequently entailed much personal sacrifice, this attitude towards it by the powers that be seems neither just nor wise, nor has it, in the opinion of the Council of the National Medical Union, the justification even of necessity if a proper use be made of the medical material available. This union, whose opposition to the Medical Benefit Section of the National Insurance Act is well known, has no desire to snatch any advantage for its views on this occasion, but it expects a like self-abnegation on the part of those interested in the maintenance of the system of medical benefit referred to.

The Council of the National Medical Union, after full discussion and after consultation with cognate bodies in other parts of the Kingdom, believes that every medical need, civil and military, may be met on the lines and upon the conditions hereunder indicated, and which should be operative during the war and for a reasonable period thereafter until the situation is again tending to become normal and the abstract questions at issue in the medical world can again be considered. They believe also that medical services secured on these conditions will be willing services, a paramount consideration in the exercise of a profession in which physical ease has largely to be sacrificed and mental activity with much responsibility displayed and borne.

The conditions indicated to secure such services are as follows: 1. A primary condition to be repeal of the Medical Benefit Section of the Insurance Acts, thereby releasing many doctors who are unevenly distributed at present and releasing a population that would automatically distribute itself in the district. 2. Non-panel practitioners offering to attend the patients of panel doctors not to be required to attend them except as private patients.

The statement adds that the importation of English-speaking doctors to attend the civil population is totally unnecessary and not in the national interests, and that compulsion in the case of the medical profession will only lead to disaster.

The Council further concludes that any voluntary organisation should be carried out by a properly constituted medical committee elected by, and representative of, the profession.

PILEWORT.

To the Editor of THE LANCET.

SIR,—In reply to Mr. F. W. Alexander's inquiry in your issue of Jan. 6th I have prescribed pilewort ever since Sir James Sawyer recommended it 16 years ago, and I cannot say it has ever failed me when properly applied. The preparation I use is that of a double cone suppository, made like an elongated dumb-bell, which is easily inserted and retained in position when grasped by both the internal and external sphincters until it is entirely absorbed. The suppositories must be made from the fresh plant, and are prepared by Messrs. Lowe and Co., Limited, 8, Stafford-street, Old Bond-street, W. Mr. Lowe informs me that it is only for about one month in the year that the plant is really active, and he thinks it is neglect of the old botanists' instructions, to "gather the plant only at the height of its short active life" that accounts for so many failures with it. Doubtless the introduction of a host of modern synthetic remedies has had a good deal to do with the neglect of this and other valuable old remedies.

I am, Sir, yours faithfully,

Jan. 20th, 1917. MAYFAIR.

THE CONSERVATIVE TREATMENT OF BURNS AND SCALDS.

To the Editor of THE LANCET.

SIR,—I am convinced from long experience in the treatment of burns and scalds that many deaths are caused from the excessive care in cleaning the wounds, which tortures the patient, and the subsequent application of painful applications. The waste of bandages is also appalling. The verdict "Died of shock from burns" I take to be the result in many cases of the long-continued pain received during the dressing. My own practice is to relieve pain with opium, morphine, cocaine, &c., and to get the patient to sleep as soon as possible. The great heat of either fire or water that caused the injury has acted as a thorough disinfectant to the clothing, which need not be removed but simply covered with cotton-wool. A few days later the wounds are easily made clean and free from clothes. Treated in this way I have never lost a patient who was burned or scalded.

I am, Sir, yours faithfully,

Catford, Jan. 18th, 1917. G. J. O'REILLY.

JAMAICA HEALTH REPORT.

IN the section of the report for 1915-16 of the Governor of Jamaica (Sir W. H. Manning, K.C.M.G., C.B.) devoted to vital statistics and public health it is stated that the estimated population on March 31st last was 894,735. The birth-rate for the year was 34·6 per 1000 and the death-rate 21·6 per 1000, as compared with 38·9 and 21·4 respectively in the previous year. 66·9 of every 100 births registered were illegitimate. This is slightly higher than the rate—66·8 per cent.—in 1914-15, which was the highest island rate recorded since the compulsory registration of births commenced in 1878. Of the total mortality the deaths of infants were: Under 1 year, 28·1 per cent.; 1 year, 8·7 per cent.; 2 years, 2·9 per cent.; 3 years, 2·0 per cent.; 4 years, 1·5 per cent. Comparing the infant mortality with the births during the year, 30,854 infants were born and 7089 died at 1 year of age or under, equal to 22·9 per cent.; the percentage under 5 years was 26·9.

Owing to the inability to obtain salvarsan for use in the treatment of yaws, the travelling dispensary and hospital established in 1914 with a view specially to the treatment of this disease was closed on June 12th, 1915. During the time the dispensary was in operation 1498 patients were treated for yaws, 408 of whom received two injections and 60 three injections. Of the patients treated 1109 were cured, 4 died, and 385 were under treatment at the time of the closing of the dispensary. The number of cases of yaws treated with salvarsan in the several public general hospitals and medical districts was 637. The Legislative Council in March voted a sum of £2500 for the purpose of providing for the special treatment in Kingston of venereal diseases, which are very prevalent, and in some places, inclusive of Kingston, appear to be on the increase.

There were 5942 cases of hookworm treated with thymol at the various country hospitals, in addition to 123 cases among East India immigrants on the estates and 142 prisoners so treated at the General Penitentiary. At the latter institution the treatment of the infection by oil of chenopodium was tried, and the surgeon reports that the results clearly demonstrate that the oil is exceedingly powerful against both hookworm and the large ascaris, and that no ill effects after dosing were observed in any case. The opportunity was taken during the year of studying, by examination of the fæces bacteriologically, the effects of thymol, quassia, and oil of chenopodium on cases from other institutions, and establishing a comparison of the respective efficacies of these drugs. The Government bacteriologist, Dr. H. H. Scott, states that the conclusions to be drawn from these experiments are: (1) that quassia is of very little, if of any, use against hookworm; (2) that thymol is not an ideal specific; (3) that oil of chenopodium appears to be a very powerful anthelmintic, though further observations are still necessary to establish this point; and (4) that the best result is to be obtained by making use of both thymol and oil of chenopodium at a suitable interval; the problem of total eradication of ankylostomiasis is, however, not one to be solved by drugs only.

Vomiting sickness caused 134 deaths during the year, as against 196 in the previous year. The investigations by Dr. Scott in support of his theory that vomiting sickness is due to a poison contained in the fruit of ackees (*Blighia sapida*) were continued. It so happened that while these investigations were being carried out there occurred a definite case of ackee poisoning, and Dr. Scott carried out a post-mortem examination, which revealed changes practically identical with those observed in the animals experimented upon. This case, which was not described as one of vomiting sickness, showed typically the onset, course, and pathological changes of that disease.

As a result of heavy rains malarial fever was prevalent throughout the island, and there was a great increase among the peasantry and labouring classes; the number of cases admitted to the various hospitals (other than in Kingston) for malaria was 7138. The total number of patients treated in public general hospitals and asylums during the year was 29,537, and the number of out-patients treated was 67,882. There were 516 deaths in hospitals.

GOOD MILK.

WE noticed in THE LANCET of Nov. 25th, 1916, p. 926, a small pamphlet on practical cow-keeping, written by the Hon. Mrs. Lionel Guest and published under the auspices of the Central Committee for National Patriotic Organisations. The complete book from which the pamphlet was compiled (*The Cow and Milk Book*, John Lane, pp. 175, price 1*s.* net) is now before us, and is a thoroughly useful little guide dealing with the cow in health and disease, the handling of milk, and the making of butter and cheese. Due stress is laid on the necessity of cleanliness, as well as of knowledge and common-sense, if this branch of farming is to be made profitable. Women, Mrs. Guest thinks, are particularly suitable for looking after live-stock, as farm animals respond to kind and sympathetic treatment. The book may well be commended to all who are keeping cows, or contemplate doing so.

THE ABBÉ HUC ON PEDICULOSIS.

To the Editor of THE LANCET.

SIR,—Everybody at the present time is interested in lice, and I think the following means of keeping them off may be worth consideration. It is given by the Abbé Huc in his volume of "Travels in Tartary and Thibet," and is probably effective, though perhaps not as elegant a preparation as might now be devised.

> Hunger and thirst, fierce winds and piercing cold, wild beasts, robbers avalanches, menaced death, and actual discomfort—all had been as nothing compared with the incessant misery occasioned by these dreadful vermin. ..... We bought a few rapeks' worth of mercury and made with it a prompt and specific remedy against the lice. You take half an ounce of mercury, which you mix with old tea-leaves previously reduced to paste by mastication. To render this softer you generally add saliva; water would not have the same effect. You must afterwards bruise and stir it awhile, so that the mercury may be divided into little balls as fine as dust. You infuse this composition into a string of cotton loosely twisted, which you hang round the neck. The lice are sure to bite at the bait, and they thereupon as surely swell, become red, and die forthwith. In China and Tartary you have to renew this sanitary necklace once a month, otherwise in these dirty countries you cannot possibly keep clear of these vermin.

I am, Sir, yours faithfully,

Matlock, Jan 22nd, 1917. S. SHORE NIGHTINGALE.

THE COMPLETE DIGESTION OF WAR BREAD.

Dr. William Bramwell (Liverpool) writes to us regarding a patient who is convinced, by an examination of his fæces, that he is passing undigested particles of so-called offal contained in the war bread. The patient, he says, while not in a position to say whether such particles in passing through the alimentary canal have given up all or any part of their nutriment before expulsion as waste, believes that his experience raises a question of vital importance with regard to the use of the R-bread. We have not overlooked the matter, and our correspondent will find an interesting reference to the subject in an annotation on whole-meal bread in THE LANCET of Dec. 2nd, 1916 (p. 919). Probably much less objection would be raised to the so-called offal (itself an objectionable term) if it were finely ground, as we think is likely to be the case in the modern milling processes. Whether fine milling is officially prescribed has not been publicly stated.

Æsculapius would like to learn from medical men having experience of it whether the prophylactic use of vaccine against winter colds has been found efficacious and lasting. He would like to know whether the vaccines lose their effect after a time.

THE address of the London Insurance Committee is now Insurance-street, W.C. The street is in the Borough of Finsbury, and was originally named William-street, but this was altered a few months ago.

COMMUNICATIONS not noticed in our present issue will receive attention in our next.

The following journals, magazines, &c., have been received:—Interstate Medical Journal, British Journal of Surgery, British Journal of Dental Science, Review of Neurology and Psychiatry, Annales de Gynécologie et d'Obstétrique, American Medicine Journal of the Royal Naval Medical Service, Clinical Medicine, American Journal of Surgery, Journal of Missouri State Medical Association, American Journal of Obstetrics, Journal of State Medicine, American Journal of Roentgenology, Mexican Review, &c.

Medical Diary for the ensuing Week.

SOCIETIES.

ROYAL SOCIETY, Burlington House, London, W

THURSDAY.—Papers:—Sir Ronald Ross, K.C.B., and Miss H. P. Hudson: An Application of the Theory of Probabilities to the Study of *a priori* Pathometry. Part II.—Dr. J. Brownlee: An Investigation into the Periodicity of Measles Epidemics in London from 1703 to the Present Day by the Method of the Periodogram (communicated by Dr. W. M. Fletcher)—Capt. J. Hammond: On the Causes Responsible for the Developmental Progress of the Mammary Glands in the Rabbit during the Latter Part of Pregnancy (communicated by Mr. J. Barcroft).—Mr. F. H. A. Marshall and Mr. B. T. Halnan: On the Post-oestrous Changes occurring in the Generative Organs and Mammary Glands of the Non pregnant Dog (communicated by Mr. J. Barcroft).

ROYAL SOCIETY OF MEDICINE, 1, Wimpole-street, W.

MEETINGS OF SECTIONS.

Friday, Feb. 2nd.

LARYNGOLOGY (Hon. Secretaries—Cecil I. Graham, Frank A. Rose): at 4 P.M.

Cases:

Dr. E. W. Scripture: (1) A Case of Speech without the Use of the Larynx; (2) Apparatus for the Graphic Record of Speech.

Sir StClair Thomson: (1) Three Cases after Laryngo-fissure of Carcinoma Laryngis; (2) Sections demonstrating Very Early Diagnosis of Carcinoma Laryngis; (3) (With Mr. Wilfred Trotter): A Case of Extrinsic Carcinoma Laryngis, Two Years after Operation; (4) Two Cases of Malignant Disease of Nasal Accessory Sinuses after Lateral Rhinotomy (Moure's operation).

Mr. Cecil Graham: A Case of Malignant Disease of Nasal Accessory Sinuses after Lateral Rhinotomy (a modification of Moure's operation).

Dr. Irwin Moore: (1) A Case of Carcinoma of Maxillary Sinus after Lateral Rhinotomy; (2) A Case of Choanal (Sphenoidal) Polypus in a Patient aged 6 years; (1) The Original Laryngeal Mirror used by Manuel Garcia.

Mr. Norman Patterson: A Case of Epithelioma of Naso-pharynx after Operation.

Dr. Jobson Horne: A Case of Choanal Polypus.

N.B.—Members of the Section of Surgery are specially invited to attend

ANÆSTHETICS (Hon. Secretaries—F. E. Shipway, Ashley S. Daly): at 8.30 P.M.

Paper:

Capt. Geoffrey Marshall, R.A.M.C. (S.R.): Anæsthetics at a Casualty Clearing Station.

ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C.

MONDAY.—4.30 P.M., Cantor Lecture:—Prof. A. B. Pite: Town Planning and Civic Architecture. (Lecture I.)

WEST LONDON MEDICO-CHIRURGICAL SOCIETY, West London Hospital, Hammersmith-road, W.

FRIDAY.—8.30 P.M., Pathological Evening.

LECTURES, ADDRESSES, DEMONSTRATIONS, &c.

POST-GRADUATE COLLEGE, West London Hospital, Hammersmith-road, W.

MONDAY.—2 P.M., Medical and Surgical Clinics. X Rays. Mr. Gray: Operations. Mr. B. Harman: Diseases of the Eye. Dr. Simson: Diseases of Women.

TUESDAY.—2 P.M., Medical and Surgical Clinics. X Rays. Mr. Baldwin: Operations. Dr. Banks Davis: Diseases of the Throat, Nose, and Ear. Dr. Pernet: Diseases of the Skin.

WEDNESDAY.—10 A.M., Dr. Saunders: Diseases of Children. Dr. Banks Davis: Operations of the Throat, Nose, and Ear. 2 P.M., Medical and Surgical Clinics. X Rays. Mr. Pardoe: Operations.

THURSDAY.—2 P.M., Medical and Surgical Clinics. X Rays. Mr. Gray: Operations. Mr. B. Harman: Diseases of the Eye.

FRIDAY.—10 A.M., Dr. Simson: Gynæcological Operations. 2 P.M., Medical and Surgical Clinics. X Rays. Mr. Baldwin: Operations. Dr. Banks Davis: Diseases of the Throat, Nose, and Ear. Dr. Pernet: Diseases of the Skin.

SATURDAY.—10 A.M., Dr. Saunders: Diseases of Children. Dr. Banks Davis: Operations of the Throat, Nose, and Ear. Mr. B. Harman: Eye Operations. 2 P.M., Medical and Surgical Clinics. X Rays. Mr. Pardoe: Operations.

ROYAL INSTITUTE OF PUBLIC HEALTH, Lecture Hall of the Institute, 37, Russell-square, W.C.

Course of Lectures and Discussions on Public Health Problems under War and After-war Conditions:—

WEDNESDAY.—4 P.M., Lecture III.:—Dr. C. J. Macalister: The Prevention and Arrest of Venereal Disease in Men. General Sir H. L. Smith-Dorrien, G.C.B, G.C.M.G., D.S.O., Dr. F. N. K. Menzies, Dr. O. May, and Major A. Corbett-Smith, R.F.A., have promised to take part in the discussion.

ROYAL INSTITUTION OF GREAT BRITAIN, Albemarle-street, Piccadilly, W

TUESDAY.—3 P.M., Prof. C. S. Sherrington: The Old Brain and the New Brain, and their Meaning. (Lecture III.)

THURSDAY.—3 P.M., Prof. F. G. Donnan: The Mechanism of Chemical Change. (Lecture I.)

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It is especially requested that early intelligence of local events having a medical interest, or which it is desirable to bring under the notice of the profession, may be sent direct to this office.

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VOLUMES for the second half of the year 1916 will be ready shortly. Bound in cloth, gilt lettered, price 16*s.*, carriage extra.

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T.—Mr. J. Thin, Edinburgh; Dr. R. H. Trotter, Huddersfield; Mr. H. B. Talt, Lond.; Dr. K. Taylor; Dr. J. B. Tuke, Lond.; Miss T.; Dr. J. T. Thyne, Lond.

V.—Dr. H. W. Verdon, Lond.; Victoria Central Hospital, Liscard, Sec. of; Dr. M. Valladad, S. Paulo.

W.—Mr. W. A. Ward, Richmond; Dr. C. W. Williams, Smallburgh; Messrs. A. J. Wilson and Co., Lond.; Mr. R. S. Walker, Lond.; Mr. W. Walker, Mid Calder; Messrs. J. Williams and Son, Bradford; Capt. H. W. Wilkinson, R.A.M.C.; Staff-Surg. R. J. Willan, M.V.O., R.N.V.R.; Mr. L. E. G. de Woolfson, Wednesfield; Dr. R. Wilkinson, Lond.; Capt. J. C. Walker, R.A.M.C.; Messrs. W. J. Wilcox and Co., Lond.; Messrs. Willows, Francis, Butler, and Thompson; Messrs. Whitcombe and Tombs, Lond.; Dr. P. W. Williams, Bristol; Dr. C. P. White, Manchester; Dr. A. C. Wilson, Formby.

Z.—Dr. S. C. Zavitzianos, Corfu.